ANZLIC - The Spatial Information Council

Economic Assessment of Spatial Data Pricing and Access

SUMMARY

November 2010

Background

Fundamental spatial data constitute data about the location and attributes of features that are on, above or beneath the surface of the earth, that are captured from primary sources and, typically, cannot be derived from other data. While there are differences between jurisdictions in the delineation of what constitutes fundamental data, examples of fundamental data include topographic information, aerial photography, the cadastre and administrative boundaries.

Fundamental data are an authoritative source of spatial data for public and private sector users and are precursors for a wide range of processed (or value-added) products, applications and data services. Spatial data are dynamic in nature and datasets usually require ongoing maintenance and updating to retain their value. Fundamental data are a form of public infrastructure, unlike many other forms of public sector information, such as reports and legal documents. Fundamental data enable important business and policy decisions and facilitate the functions and operations of many government agencies.

Fundamental data have historically been produced and maintained by government agencies as part of the core activities of the agencies. Typically, one agency within each jurisdiction has assumed a role as an aggregator of fundamental data from the source agencies. The land information agency typically processes that data to a 'fit for purpose' state and acts as a 'shop front' for sale and distribution to other government and private sector users. A central element of the sale and distribution role is determining and implementing policies on the prices that the agency charges to government and private purchasers of fundamental data.

There is no common or shared view across governments in Australia and New Zealand on how fundamental data should be priced, or the terms under which they should be made available to users. Recent international and Australian inquiries have called for public sector information (which would include fundamental spatial data) to be provided free on-line or at 'marginal cost', with the aim of making this information more affordable to a larger suite of users and stimulating greater levels of use and innovation in products, applications and services that use the information. ANZLIC – the Spatial Information Council (ANZLIC) is concerned that proponents of the 'free on-line' model have not considered the full economic implications of this approach on the long term sustainability of the spatial data industry. A particular concern is that the free provision of fundamental data relies on governments fully funding the necessary activities of production, maintenance and distribution of the data and there is a risk that erosion of government funding will lead to a decline in the quality of fundamental datasets.

Against this backdrop, ANZLIC decided to conduct an analysis of the economic fundamentals surrounding the creation, management, maintenance and provision of access to spatial data. ANZLIC has recognised a potential benefit in having a robust framework for managing access to, and pricing of, fundamental data to support the development and sustainability of the spatial data industry. ANZLIC accordingly commissioned this study by PwC to undertake an economic assessment of alternative models of access and pricing for fundamental data.

The study has been undertaken in two stages. Stage One developed guiding principles for access to, and pricing of fundamental data and defined four alternative pricing models. Stage Two comprised a comparative analysis of the economic benefits and costs of the alternative models. Separate reports have been produced for each of these stages.

The analysis undertaken in this study built on previous economic studies of spatial data pricing and access in the following ways.

- The analysis explicitly addressed the dynamic effects of pricing models – addressing factors such as changes over time in funding for the producer agency and implications for data quality (accuracy, currency, and resolution). PwC used a dynamic modelling approach to evaluate the economic implications of changes in funding, changes in data quality and consequent changes in benefits to society from data use (measured as the economic concepts of consumer and producer surplus).
- An assessment was made of the capacity of alternative pricing models to address the public good characteristics of spatial data, the effect of pricing signals on consumption and production decisions (including the efficient level of investment in data quality) and the dynamics of competition and innovation.

Guiding principles for access to, and pricing of, fundamental data

The following principles should guide selection of an access and pricing model.

- Governments should not impose any 'hard constraints' to access to fundamental data (that is, non-price constraints) unless there is a defensible public interest reason for restricting access.
- Access and pricing policies should promote efficiency in the production and consumption of fundamental data.
- Pricing policies should take into account the public good nature of fundamental data and the possibility of positive spillover benefits from its use.
- Pricing policies should be equitable, with prices charged to different users reflecting the differences between classes of users in the benefits gained from use of the data and the capacity to pay.
- Access and pricing policies should be consistent with the principle that government businesses do not enjoy competitive advantages over their private sector competitors simply by virtue of their public sector ownership.
- Pricing and access policies should be applied to specific fundamental data or classes of data and not to an agency as a whole.

Alternative pricing models

Different pricing models vary in the extent and manner in which users of fundamental data are charged prices to recover costs of production and distribution of the fundamental data.

PwC identified four models for managing the pricing of fundamental data for assessment. These lie on a spectrum of approaches that are differentiated by the extent to which costs are recovered, and by the extent to which there are differences in prices charged to commercial and non-commercial users of data.

At one end of the spectrum of models is the '**full cost recovery model**' in which data are priced to recover all of the costs (the 'full cost') of producing, maintaining and distributing fundamental data from users. The data are licensed such that each new data user is required to purchase the data product from the land information agency at a price

that enables the agency to recover the full cost of the data when all data purchases are taken into account. Prices would apply uniformly to commercial and non-commercial users.

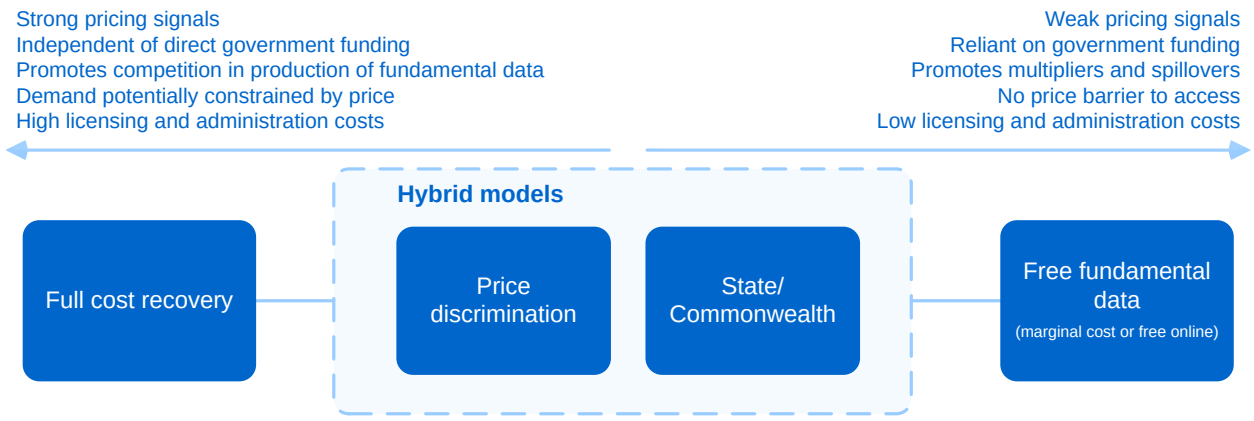
At the other end of the spectrum lies the '**free fundamental data model**' in which fundamental data are priced to recover only the marginal cost of distribution. For electronic distribution of data, such as through internet channels, the marginal cost of distribution is so low as to be effectively zero, and hence the data are made available to users for free. Under this model, governments finance all of the costs of data production, maintenance, extraction and distribution.

In between these two models is the '**price discrimination model**', which applies differential pricing according to customer type. Commercial users are supplied with data at a price based on recovery of full cost, while non-commercial users, including other government agencies, are provided with data at the marginal cost of distribution or for free. Under this model, revenues from commercial users and from government funds finance the costs of data production.

The '**Commonwealth/State model**' is a hybrid of the above models. This model involves the Commonwealth Government providing fundamental data under a free fundamental data model, and state governments providing data under the full cost recovery model.

The alternative pricing models have different consequences for the economics of data production and consumption, which are indicated in Figure 1.

Figure 1: Pricing and access models identified for analysis



Comparative analysis of pricing models

Economic benefits derive from the production and use of fundamental data. The four pricing models were compared on the basis of the changes in the economic benefits that would occur in changing from one pricing model to another such as, for example, changing from the free fundamental data model to the full cost recovery model, or vice versa.

We undertook the comparative analysis in four stages:

- a static welfare analysis to estimate quantitatively the benefits accruing to the producers and consumers of spatial data under each model;

- a dynamic welfare analysis to estimate quantitatively the change in benefits accruing to producers and consumers of spatial data over time due to changes in funding or quality;
- qualitative consideration of a number of other factors including competition and innovation in production of spatial data, data quality, public good values, positive spillovers from use of fundamental data, equity in data availability and pricing, complexity of pricing models, and access to raw data (fundamental data are typically processed to a 'fit for user' state before sale); and
- application of the welfare analysis to four State and Commonwealth fundamental data products.

Results of this analysis demonstrate that there is no uniquely optimal access and pricing model when a range of practical and dynamic considerations are taken into account. Rather, the access and pricing model with greatest economic benefit varies with differences in the broader economic and policy context for production and consumption of fundamental data.

Of particular significance amongst the elements of the economic and policy context is whether governments will be prepared to fully fund the production and distribution of fundamental data given competing priorities for government spending.

If adequate government funding can be relied upon, the free fundamental data model delivers greater economic benefits than the alternative models. The larger benefits result from increases in the use of fundamental data that would occur as a result of the data being provided for free or at a very low price, and flow-on effects of increases in competition and innovation in downstream markets for products and services that use fundamental data. However, the achievement of these benefits also requires that certain other conditions hold, notably that:

- the government agencies that produce the data do not rely on the purchasing decisions of data users to provide signals to guide decisions on the quality of the data; and
- the benefits of free provision of fundamental data are not negated by fewer market opportunities for competition and innovation by non-government producers of fundamental data.

Where these conditions do not hold, the benefits of the free fundamental data model may not be sustained and models that allow for cost recovery are superior in the longer term. The comparative analyses of the current study show that the full cost recovery model is superior where the free fundamental data model results in deterioration in the quality of fundamental data over time due to funding constraints or misspecification of data quality.

The comparative analyses also show that the price discrimination model achieves most of the economic benefit of the free fundamental data model, particularly where there is a significant government share of data use. The price discrimination model provides a trade off between the independent-funding benefits of the full cost recovery model and greater-use benefits of the free fundamental data model. The price discrimination model has benefits of:

- a high level of use of fundamental data in policy and administrative processes of government agencies;
- a funding stream for fundamental data production and distribution that is at least partly independent of government funds; and
- decisions of data producing agencies on data quality being guided by market signals from purchases of commercial users of data at full cost recovery prices.

The optimal pricing model may vary depending upon government objectives

Governments and land information agencies may have a range of policy objectives and priorities that will affect the optimal choice of pricing model for fundamental data. Differences in objectives may cause different pricing models to be optimal for different jurisdictions.

Table 1 indicates how different policy objectives and priorities affect the optimal choice of pricing model. The number of ticks in each cell of the table indicates how well a pricing model performs against the objective, with three ticks indicating the best performance.

Differences in government objectives may be reason for variance between jurisdictions in the optimal pricing model. Jurisdictions may adopt the Commonwealth / State model on this basis.

Table 1: Delivery of objectives by model

Objective	Full cost recovery	Price discrimination	Free fundamental data
Economic development	✓✓ Less benefit than alternative models in short term, but may be superior in long term due to access to revenues as a funding stream for data production	✓✓ Less support to economic development than the free fundamental data model but the gap is small where the share of use by non-commercial user is large	✓✓✓ Maximises the use of fundamental data and the contribution and spillover benefits of fundamental data. Benefit may decline in long term if government funding for data production is not maintained
Use of fundamental data by government agencies	✓✓ Government agencies have to pay for use of fundamental data and hence are motivated to reduce use	✓✓✓ Government agencies receive fundamental data for free or minimal price and hence are motivated to maximise use	✓✓✓ Government agencies receive fundamental data for free or minimal price and hence are motivated to maximise use
Generation of government revenue	✓✓✓ Maximises revenue generation and makes data production independent of direct appropriations of government funding	✓✓ There is some reduction in government revenue where fundamental data are used by non-commercial users.	No revenue generated
Accountability of data producers to funders of data production	✓✓✓ The requirement of land information agencies to derive revenues from data sales makes these agencies responsive to the needs of data users	✓✓ Land information agencies may be responsive to the needs of commercial users of data, but less responsive to government and non-commercial users	✓ As land information agencies do not rely on revenues from data sales, there is no commercial incentive to be responsive to the needs of data users
Availability of data to the community to inform public participation in public policy and government decision making	✓ Public, non-commercial use of fundamental data may be restricted by limited capacity to pay prices.	✓✓ Fundamental data are freely available to non-commercial users	✓✓✓ Fundamental data available to all commercial and non-commercial users
Promotion of competition in production of fundamental data	✓✓✓ Competition in production of fundamental data is promoted as private firms may compete on a competitively neutral basis with government land information agencies	✓✓ Free provision of fundamental data to government agencies and non-commercial users limits the market opportunities for private data production firms	✓ Free provision of fundamental data from government land information agencies lessens commercial opportunities for private data production firms
Promotion of competition in downstream markets for services and products using fundamental data	✓ Less use of fundamental data reduces the opportunities for competition in products and services	✓ Less use of data by commercial users reduces the opportunities for competition in products and services	✓✓✓ Free provision of fundamental data promotes competition in products and services

Note: the tick scores indicated in this table indicate relative performance against policy objectives and are not intended to be interpreted as a quantitative assessment of benefits or to be additive across multiple policy objectives.

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Stage 1 Report: Principles, Issues and Alternative Models

November 2010

Contents

1 Executive summary

Background

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Fundamental data are an authoritative source of spatial data for public and private sector users and are precursors for a wide range of processed (or value-added) products, applications and data services. Spatial data are dynamic in nature and datasets usually require ongoing maintenance and updating to retain their value. Fundamental data are a form of public infrastructure, unlike many other forms of public sector information, such as reports and legal documents. Fundamental data enable important business and policy decisions and facilitate the functions and operations of many government agencies.

Fundamental data have historically been produced and maintained by government agencies as part of the core activities of the agencies. Typically, one agency within each jurisdiction has assumed a role as an aggregator of fundamental data from the source agencies. The land information agency typically processes that data to a 'fit for purpose' state and acts as a 'shop front' for sale and distribution to other government and private sector users. A central element of the sale and distribution role is determining and implementing policies on the prices that the agency charges to government and private purchasers of fundamental data.

Governments in Australia and New Zealand have no common or shared view on how they should price fundamental data, or the terms under which they should make fundamental data available to users. Nor is there clarity about what should be included in the 'fundamental data' category or the quality standard to which the data should be maintained (in terms of currency, accuracy and geographic coverage). There is also debate about whether the land information agency should release the raw data that underpins the fundamental data prior to basic processing.

Most state and territory governments have adopted the approach of supplying 'fit-for purpose' fundamental data to commercial users at prices that aim to recover total costs and, in some cases, generate a surplus. Non-commercial users are usually supplied with data at a discount or at less than full cost. However, there are divergent views on this approach to pricing. The policy position of the Commonwealth Government is to make fundamental spatial data sourced from federal agencies available to all parties at no cost via the internet (Commonwealth Interdepartmental Committee on Spatial Data Access and Pricing, 2001).

Furthermore, a number of recent international and Australian inquiries[1] have called for public sector information to be provided free on-line or at 'marginal cost', with the aim of making this data more affordable to a larger suite of users, thus stimulating greater

[1] For example, the Victorian Parliamentary Inquiry into Improving Access to Victorian Public Sector Information and Data (2008), Government 2.0 Task Force: Improving Access to Public Sector Information — A Framework (2009) and a UK study by Pollock, Newbery and Bently (Models of Public Sector Information Provision via Trading Funds — 2008).

innovation and uptake. The benefits of reduced administration costs of licensing and pricing have also been used by proponents of this model. However, these reports have not considered all the implications of this approach in terms of welfare impacts along the value chain.

This study

In commissioning this study, ANZLIC – the Spatial Information Council (ANZLIC) has recognised a potential benefit in having a robust framework for managing access to, and pricing of, fundamental data to support the development and sustainability of the spatial data industry.

ANZLIC is concerned that proponents of the 'free on-line' model have not considered the full economic implications of this approach on the long-term sustainability of the spatial data industry. A particular concern relates to the risk of erosion of funding available for the ongoing production and maintenance of high quality, authoritative datasets. Against this backdrop, ANZLIC considers that it is now opportune to conduct a holistic analysis of the economic fundamentals surrounding the creation, management, maintenance and provision of access to spatial resources.

This report presents PwC's findings for Stage One of the study — which is a scan of the issues, the establishment of guiding principles for pricing and access and the identification of a range of alternative model 'constructs' for managing the pricing of, and access to, fundamental data. In a second stage of the study, we make an economic analysis of the economic benefits and costs of each model.

A range of approaches to pricing fundamental data are currently employed

In Australia, fundamental data are made available under a range of different pricing approaches. The main distinguishing difference between the jurisdictions is the extent of price differentiation between customer classes and the degree of cost recovery. Some jurisdictions adopt full cost recovery for supply to commercial end users, with fundamental data for non-commercial uses provided at a price reflecting the avoidable or marginal cost, or free of charge. The various pricing approaches currently practised are as follows:

- *Full cost recovery*: price is determined with regard to all costs attributed to data production, including collection, processing, maintenance and distribution. Under this approach, overhead costs are usually 'fully distributed' across all products.

- *Commercial pricing*: pricing reflects full cost recovery plus a commercial mark-up, representing a profit or surplus component.

- *Marginal cost pricing*: price is equal to the cost of supplying an extra unit of a good or service. It represents only the variable costs of production and approximately equates to the cost of extraction and distribution. The marginal cost of extraction and distribution for one additional customer is effectively zero for data supplied online (although some policies define extraction and distribution to include a share of overheads).

- *Avoidable cost pricing*: price is equal to the costs that would be avoided if production (or distribution) of a particular output was ceased. It includes all variable costs plus a share of fixed costs attributable to the production and supply

of a data set (infrastructure, corporate overheads etc). The share is defined by the costs that would be avoided.

The variety of pricing policies implemented results in a similarly diverse range of licences being applied to the spatial data. Typically, where pricing is above marginal cost, restrictions are placed on distribution and re-use, with royalty payments required for revenue obtained from commercial use of the data. Marginal cost pricing attracts more liberal licensing, such as the Creative Commons suite of licences. Creative Commons is a non-profit organisation that has built a range of free licences that allow content owners to specify which rights they retain in their works and which rights they will waive. The licences are designed to facilitate the distribution, re-use and remixing of intellectual property.

The need for clarification of pricing and access objectives

A central finding of this study is that there are multiple objectives that could be pursued in setting prices and access policies, some of which are competing. One of the problems at present is that these objectives have not been clearly articulated at a whole-of-industry level (including private and public sectors) and there is poor recognition about how they relate to the various pricing approaches.

Depending on the approach adopted, more or less of each of the following objectives could be achieved:

- promotion of economic development
- facilitation of effective public policy decision making and efficient delivery of government services
- generation of revenue to cover costs and/or generate a return on investment
- government accountability (referring to the potential for access to public sector information to promote public participation in decision making and scrutiny of government, and the scope for prices to improve the internal discipline in government to achieve efficiencies in service provision)
- promotion of competition by addressing anti-competitive pricing and access
- protection of intellectual property, privacy and national security
- restriction on access for pricing purposes.

The challenge for government and industry is therefore to recognise the inherent trade-offs between some of these objectives, then select a pricing and access approach that offers the best overall outcome for the spatial data industry.

Principles

In addition to the prerequisite of having clear objectives, we identified the following principles for guiding the development of a pricing and access framework for spatial data.

- By default, government should impose no ‘hard constraints’ to access (that is, non-price constraints) unless there is a defensible public interest reason for constraining access.

- Pricing and access should promote efficiency in the production and consumption of spatial data. Efficiency considerations include the provision of appropriate cost-reflective pricing signals to users, avoidance of duplication of effort and minimisation of transaction costs.

- Prices and cost recovery policy should be adjusted to take into account the public good nature of fundamental spatial data and the possibility of positive spillovers from its use.

- Pricing and access should be equitable — in terms of applying a ‘beneficiary pays’ approach and giving consideration to recovering a greater share of costs from those with the greatest capacity to pay.

- Pricing and access policies should be consistent with competitive neutrality, meaning that any advantages or disadvantages conferred on a government agency by way of public ownership should be taken into consideration when determining prices for fundamental data.

- Pricing and access policies should be applied to specific fundamental datasets or classes of data and not to an agency as a whole.

Funding issues

From our consultations we found that there is poor recognition in Australian central government and treasury departments about the value of spatial data as a form of public infrastructure. This is giving rise to concerns in the spatial data industry that adoption of a ‘no-charge’ or marginal cost model for supply of fundamental data would be risky for land information agencies, as the loss in revenue through sales may not be replaced with public funding (or initial funding replacement could erode through time).

In contrast to many other forms of public sector information, fundamental spatial data requires on-going maintenance and upgrading of distribution infrastructure if it is to retain its value as a public resource. This implies that a stable and certain source of funding or revenue is required. There is a direct cost to government associated with making fundamental data free, unlike the provision of free access to other materials such as public reports and historical databases that are not maintained.

There is some support in parts of government for the principle that land information agencies should seek to generate a return on tax-payers’ investment in the fundamental data ‘asset’ and associated distribution infrastructure. However, the balance of our findings supported the principle that a commercial return on investment should only be sought where efficiency considerations or broader welfare-based objectives justify it.

Efficiency issues

Cost-reflective pricing provides a potentially valuable mechanism for signalling the willingness to pay by consumers for data and services. Where there is a degree of discretion around the level of quality to which fundamental data should be supplied, demand signals from consumers at various price points could provide some information about market willingness to fund the extra investment required to achieve a particular

quality standard. Efficiency principles dictate that customers should pay at least the supplier's avoidable cost of servicing that customer.

If fundamental data are to be provided for free or at below 'avoidable cost', the quality-price demand feedback signal is no longer available to government. This may not be a critical issue, provided that alternative means of assessing the cost-benefit of supplying data of particular quality standards and type can be performed cheaply.

Some stakeholders expressed concern that the cost recovery policies of land information agencies could be creating a perverse incentive for these agencies to adopt inefficient levels of service delivery, particularly for products where there is no competitive market. Some industry participants thought that a focus on cost recovery for some products/customers was resulting in a failure to give sufficient attention to maintaining those products that were provided free of charge.

A number of people consulted raised concerns about the possible duplication of fundamental datasets along the value chain and the inherent inefficiencies arising from this. Land information agencies suggested that this is a good reason for not releasing fundamental data in less processed, raw form. However, others noted that the cost efficiencies generated through the potential for increased competition arising from access to raw data may outweigh the possible duplication inefficiencies.

Other key issues

The demand for, and supply of, spatial data is rapidly changing with technological advances — for example, user-generated data are providing the private sector with a new, low-cost source of spatial data and the internet has reduced distribution costs and given rise to new spatial data applications and decision tools. Advancing technology and alternative business models being employed by the private sector is reducing the supply and distribution costs of some types of fundamental data — and this may place downward pressure on the commercial prices charged by public land information agencies. PwC concludes that technological change is likely to change the competitive landscape in the development and supply of spatial data.

There are divergent views among stakeholders about the most appropriate licensing framework for fundamental data. Our assessment is that adequate control of spatial data can be maintained through the use of metadata and a well tested licensing regime.

Alternative pricing and access models

Different pricing models vary in the extent and manner in which users of fundamental data are charged prices to recover costs of production and distribution of the fundamental data.

PwC identified four models for managing the pricing of fundamental data for assessment. These lie on a spectrum of approaches that are differentiated by the extent to which costs are recovered, and by the extent to which there are differences in prices charged to commercial and non-commercial users of data.

At one end of the spectrum of models is the '**full cost recovery model**' in which data are priced to recover all of the costs (the 'full cost') of producing, maintaining and distributing fundamental data from users. The data are licensed such that each new data user is required to purchase the data product from the land information agency at a price that enables the agency to recover the full cost of the data when all data purchases are

taken into account. Prices would apply uniformly to commercial and non-commercial users.

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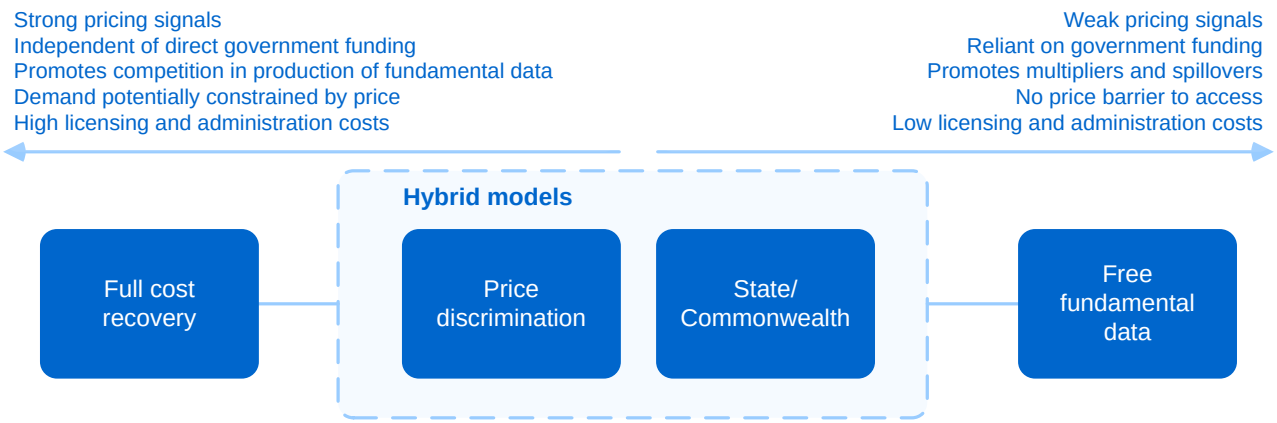
In between these two models is the '**price discrimination model**', which applies differential pricing according to customer type. Commercial users are supplied with data at a price based on recovery of full cost, while non-commercial users, including other government agencies, are provided with data at the marginal cost of distribution or for free. Under this model, revenues from commercial users and from government funds finance the costs of data production.

The '**Commonwealth/State model**' is a hybrid of the above models. This model involves the Commonwealth Government providing fundamental data under a free fundamental data model, and state governments providing data under the full cost recovery model.

The alternative pricing models have different consequences for the economics of data production and consumption, which are indicated in Figure 1.

Figure 1: Pricing and access models identified for analysis



2 Introduction

2.1 Background

Location (spatial) data are an integral component of most public sector information. Increasingly, electronic data on the physical location of objects and the metric relationships between objects is becoming an important 'enabler' of economic development and better public decision-making. It is now estimated that approximately 80 percent of government captured data contains a spatial element (Martin, 2008).

This report focuses on one class of spatial data, referred to as 'fundamental data' or the 'basic information set'. In this report, fundamental data are defined as follows:

> An authoritative source of spatial data that are maintained to well defined quality standards and cannot be derived from another dataset.

Fundamental datasets are therefore precursors for a wide range of processed (or value-added) products, applications and data services.

In Australia and New Zealand, most fundamental data are collected, processed and distributed by government land information agencies at state and federal level. This is partly a consequence of the 'natural monopoly' characteristics of these data products (which prevent a competitive market in the supply of this data) and government's need for this data in many aspects of public service provision — for example, emergency services and natural resource management. However, as will be shown in this report, there is evidence of increasing private sector and community involvement in the production of some types of fundamental data.

Governments in Australia and New Zealand have no common or shared view on how they should price fundamental data, or the terms under which they should make fundamental data available to users. Nor is there clarity about what should be included in the 'fundamental data' category or the quality standard to which the data should be maintained (in terms of currency, accuracy and geographic coverage). There is also some debate about whether the raw data (see glossary) that underpins the fundamental dataset should be released prior to basic processing.

Most state and territory governments have adopted the approach of supplying 'fit-for purpose' fundamental data to commercial users at prices that aim to recover total costs and, in some cases, generate a surplus. Non-commercial users are usually supplied with data at a discount or at less than full cost. However, there are divergent views on this approach to pricing. The policy position of the Commonwealth Government is to make fundamental spatial data sourced from federal agencies available to all parties at no cost via over the internet (Commonwealth Interdepartmental Committee on Spatial Data Access and Pricing, 2001).

Furthermore, a number of recent international and Australian inquiries[2] have called for public sector information to be provided free on-line or at 'marginal cost', with the aim of making this data more affordable to a larger suite of users, thus stimulating greater

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innovation and uptake. The benefits of reduced administration costs of licensing and pricing have also been used by proponents of this model.

In commissioning this study, ANZLIC – the Spatial Information Council,[3] has recognised a need for a holistic and robust approach to managing access to, and pricing of, fundamental data to support continuous development and sustainability of the spatial data industry.

ANZLIC is concerned that proponents of the 'free on-line' model have not considered the full economic implications of this approach on the long term sustainability of the spatial data industry. A particular concern relates to the risk of erosion of funding available for the ongoing production and maintenance of high quality, authoritative datasets. Against this backdrop, ANZLIC considers that it is now opportune to conduct a holistic analysis of the economic fundamentals surrounding the creation, management, maintenance and provision of access to spatial resources.

2.2 Study objectives and terms of reference

The primary objective of this project is to develop a principles-based framework for accessing and pricing fundamental spatial data. The full set of economic implications (costs and benefits) of alternative models for pricing/access are to be examined, with reference to the value chain for the production of and access to spatial data. Explicit account is to be taken on the dynamic nature of the costs and benefits due to technological changes, and consequent changes in supply and demand fundamentals.

It is not the intent of this study to recommend a single, preferred model for the whole of Australia and New Zealand. Instead, the role of this report is to present a comparative analysis of the various approaches and to identify how well each performs against alternative policy objectives — for example, efficiency, equity, economic development, revenue generation, innovation and data quality.

PwC has been tasked with undertaking an economic analysis that:

- identifies alternative pricing and access models for the overall spatial data management value chain, encompassing the sustainable collection, management, distribution, use, provision of access and commercialisation of 'fit for purpose', public sector spatial data
- compares the costs and benefits of a marginal cost pricing approach as compared to cost recovery models
- provides some hard, dynamic economic analysis, taking into account longer term implications, that can:
  - elaborate on recent local and international research to appropriately provide and price access to 'fit for purpose' spatial data rather than just focussing on demonstrating the economic value of spatial data or the rationale for providing raw spatial data at marginal cost

[3] Formerly known as the Australian and New Zealand Land Information Council (ANZLIC)

  - incorporates all of the complex factors: different classes of users; their willingness to pay; the impact of price signals on market efficiency and the role of differential versus uniform pricing regimes
  - be used by governments to consider the key issues and provide clear access and pricing policy advice

- takes account of the practical realities of Commonwealth-State constitutional, structural and funding arrangements and the emerging needs of the spatial data industry.

2.3 Approach

A two-stage approach has been taken to this study. Stage One is now complete and forms the basis of this initial report.

Stage One involved a scan of the issues, the establishment of guiding principles for pricing and access and the identification of a range of alternative model 'constructs' that could be applied to pricing fundamental data.

This incorporated:

- A thorough literature review and critical assessment of pricing/access models and policies applied in Australia, New Zealand and overseas.

- Extensive consultation with land information agencies, industry peak bodies and other relevant stakeholders. Approximately 20 in-depth interviews were conducted over the course of six weeks. The purpose of the consultations was to develop an understanding of the issues confronting the industry, particularly regarding the pricing, funding, quality, and accessibility of spatial data. The consultations provided information for a number of case studies relating to experiences with existing pricing/access regimes.

- A stakeholder workshop involving approximately 15 participants from land information agencies, relevant commonwealth agencies, industry representatives and individuals representing spatial data businesses. The purpose of the workshop was to confirm the findings and issues arising from the consultations above and present

- An industry survey issued to approximately 40 users of spatial data from various parts of the 'spatial community', including value added resellers, brokers, consultants, research and education institutions. The focus of this survey was on collecting information about industry's experience with existing pricing and access policies and views on alternative models that may better serve the long term needs of industry. Eleven organisations responded to the survey, with nine answering all survey questions.

Stage Two will involve an economic cost-benefit analysis of the implications of each of the alternative models defined in Stage One. This part of the project is still in progress and is due for completion in June 2010.

2.4 Organisation of this report

The rest of this report is structured as follows:

Chapter 3 contains an analysis of the characteristics of fundamental spatial data that have relevance for pricing and access. These characteristics are documented at the commencement of the study as they are important for understanding the suitability of different pricing approaches.

In Chapter 4 we profile the spatial data industry in Australia. The value chain for spatial data production and consumption is described, together with a summary of the main participants along the value chain.

Chapter 5 introduces the main pricing and access policies currently used in Australia, New Zealand and in several other countries. In the case of Australia, our attention is focused on three jurisdictions with well developed policies: those of the Commonwealth, Victoria and Western Australia. A chronology of relevant policy developments is also summarised. Detailed critical analysis of the performance of each policy against a range of criteria is undertaken in a subsequent section of the report, following the principles and objectives chapter.

In Chapter 6 we establish a set of guiding principles for consideration in development of a pricing and access regime for spatial data. While each of the principles in isolation is relatively uncontroversial, their practical implementation naturally results in trade-offs, depending on the objectives being sought. We identify the various objectives, some of which are competing, and highlight the importance of being clear about the policy objective prior to developing an access/pricing framework.

Chapter 7 contains a discussion and analysis of the issues relating to pricing and access of spatial data. The issues are grouped into several broad categories — funding, efficiency, adaption and change, access, and governance and implementation.

In Chapter 8 a comparative assessment is made of the existing Australian approaches to pricing fundamental spatial data against the range of principles identified earlier.

Chapter 9 sets out four alternative pricing and access models. The models represent conceptual ‘constructs’ as opposed to fully operational models. Several of the models contain minor variants within the broad construct. In this chapter we make a qualitative assessment of the pros and cons of each model, with reference to the principles and objectives identified earlier in the report.

The models emerging from Stage One of the study are proposed as candidates for the cost-benefit analysis to be undertaken in Stage Two.

3 Fundamental spatial data

Fundamental spatial data, as the term is used in this project, is defined as datasets that are an authoritative source for public and private sector users and which are generally more evolved than raw “data dumps”. For example, raw topographic data would be processed and integrated into an existing topographic database, at which point it would be considered to be part of the fundamental data product.

Fundamental data cannot typically be derived from another dataset. Fundamental spatial data are differentiated from integrated or bundled data or products customised for a particular purpose. Fundamental data are mostly used as an input to a value-adding process, with further processing and transformation to increase value.

Fundamental data includes the cadastre, roads, administrative boundaries, basic topographic data and physical features. While there are differences in the delineation of what constitutes fundamental data between jurisdictions, this report does not seek to reconcile those differences on the margin. Further discussion on the delineation of fundamental data is provided in section 3.2.

Further, the selection of which products form part of the fundamental dataset could be considered subject to the analysis in this report. As is the case for the “basic information set” produced by the Australian Bureau of Statistics, the economic characteristics of each spatial dataset may be used to define whether it is fundamental (for example, whether utilisation of the data generates positive spillovers or has public good characteristics).

This chapter sets out the characteristics of fundamental spatial resources that are relevant to pricing and access and delineates what datasets are typically considered to comprise fundamental data.

3.1 Characteristics

Fundamental spatial data have a number of characteristics that are relevant when considering pricing and access issues.

Natural monopoly

As is the case for many data products, fundamental spatial data production exhibits natural monopoly characteristics. There is a ‘natural’ tendency towards forming a monopoly as production involves high fixed costs but a low marginal cost.

Fixed costs include the labour costs of data collection (e.g. surveying) and the costs of information and communications technology infrastructure for data distribution. Fixed costs are incurred irrespective of the number of datasets produced or disseminated. This means that the cost of producing the original dataset is high while the costs of replicating the dataset and its subsequent distribution are close to zero. As a result of the large fixed cost base, it is more efficient for fundamental data to be captured once by a single industry participant with subsequent distribution to others.

However, these natural monopoly characteristics may be changing, with advances in technology rapidly reducing the fixed costs of collection for some spatial datasets. Effects of technological change on the demand for and supply of spatial resources are discussed in section 7.3.

Public good characteristics

Spatial datasets exhibit public good characteristics. A good is considered public when its provision to one consumer does not affect its availability and cost to others. This definition implies two characteristics of a public good: non-rivalry and non-excludability.

Non-rivalry means that use of a dataset by one customer does not reduce the amount available to others. Where it is in a digital form, data are generally non-rival, although spatial data in the form of publications may be rivalrous.

Non-excludability implies that once the dataset is available to some, others cannot be precluded from using or re-using it. Depending on the nature of the copyright protection, spatial data possesses varying degrees of excludability. Use and re-use of datasets can be restricted through intellectual property rights. However, the Productivity Commission (2001) suggest that *desirability* of excluding use is the relevant consideration from a public policy perspective. Quiggins (2009) also suggests that “most kinds of information are effectively non-excludable” as the development of the internet made legal constraints largely futile, with the enforcement costs outweighing the benefits.

Spillover effects

Fundamental datasets may produce positive spillover effects. Spillover effects (or externalities) are indirect welfare effects on firms or individuals other than producers or consumers of the good. They can be positive or negative. Fundamental spatial data can, for example, have the positive spillover of creating a better informed community which can then enable greater community participation and possibly better decision making.

The size and nature of positive spillovers may depend on whether the data are used for commercial or non-commercial purposes. Benefits created when the data are used for commercial purposes may be private and excludable, reducing the likelihood of positive spillovers. Use of data in public policy decision making and public research and development may have greater potential to generate positive spillovers.

Form of public infrastructure

Fundamental data are a form of public infrastructure; this characteristic sets it apart from many other forms of public sector information, such as reports and legal documents. Fundamental data enable important business and policy decisions and facilitate public institutions to function and operate. This, in turn, facilitates provision of essential goods and services for which there is no market. For example, spatial resources enable emergency services to determine effective response mechanisms to emergencies and onset hazards.

Maintenance and quality

Spatial data are not an information product that can be produced once and then forgotten. Spatial data are dynamic and usually requires ongoing maintenance and updating if it is to retain its value. Spatial data such as the cadastre, roads, electoral boundaries and physical features undergo ongoing change and a failure to reflect this change in the relevant dataset can reduce the value of that data.

Government agencies have some discretion in establishing standards to maintain data quality. Criteria can be set out in relation to quality attributes, such as data currency,

accuracy, resolution and geographic coverage. These standards may be made available to the public in the form of policies and guidelines. There is no 'natural' optimal quality standard for spatial data and decisions are usually made on the basis of collection and processing cost, availability of funding, the nature and scale of public benefits arising from using the data and the willingness of end users to pay for data of a particular quality. Production costs and user demands change over time with technological advances and other exogenous factors such as demands in related markets for products and processes that have a dependency on spatial data.

Value in application of the dataset

Although spatial data are of value to market participants, the value realised by end users is based on application of the dataset. Thus, 'fitness-for-purpose' of the dataset is the key underlying characteristic of future value. The dataset is most valuable when it incorporates all end user specifications and can be easily integrated into applications. This can imply further processing and transformation of fundamental data.

Both land information agencies and value added resellers (VARs) provide data customised to meet needs of end users. While this is typically a non-core activity for most land information agencies, VARs specialise in provision of fit-for-purpose data to end users. Examples of value adding activities undertaken by VARs are provided in chapter 4.

Government involvement

There are a number of factors that make the public sector a suitable collector and maintainer of fundamental spatial data.

While private sector participants may collect some spatial data, the public sector already collects some of the data as part of performing its routine activities either to fulfil its obligations or to enable decision making. Thus, some of the data are collected irrespective of its potential value to end users (Longhorn and Blakemore, 2008; ACIL Tasman, 2008). However, much spatial data are directly collected with the express purposes of developing the datasets.

There are also some institutional restrictions on data collection. Only governments can commission the collection of data through imposing national surveys and censuses, even if the collection itself is outsourced to the private sector (ACIL Tasman, 2008). Regulatory activities from which data are often collected are also the domain of government, such as registration of title over property.

The natural monopoly characteristics of fundamental spatial data may lead to a lack of competition between private sector participants and formation of a private (rather than public) monopoly around data capture and maintenance. The shift of pricing power to the private sector would require a robust regulatory framework to ensure competitive pricing of the data. However, costs associated with enforcing and monitoring compliance may be avoided if the public sector controls collection of spatial data.

The public good characteristics and spillover effects of fundamental spatial data may also provide a rationale for the involvement of government in its production. As public goods and goods with positive externalities may be under-produced by the private sector, government may fill this gap.

Government may also be more likely to produce data with features such as full jurisdictional coverage. A private company may tend to focus on areas from which it can extract the most value, leaving spatial coverage of areas incomplete.

Despite the rationale for government involvement in the production of fundamental spatial data, private sector involvement in the area is growing. Examples that are examined in more detail later in this report include the private sourcing and processing of satellite technology, user generated data and aerial imagery. The trend toward greater private sector involvement is partly as a consequence of an increased level of outsourcing by government, with the private sector increasingly carrying out collection activities. It leads to a decline in the natural monopoly characteristics of spatial data, making competition by private sector firms more feasible. Many industry survey participants saw technological change as a major driver of this trend.

3.2 Delineation of fundamental spatial data

The definition of what constitutes fundamental data varies across New Zealand, the Commonwealth and the Australian states and territories.

Western Australia and the Commonwealth have established formal schedules of those data sets considered to be fundamental spatial data. These schedules are contained, respectively, in the *Western Australian Land Information Authority Regulations 2007* and the *Commonwealth Policy on Pricing of Fundamental Spatial Data*.

In a case of Western Australia, the Western Australian Land Information System (WALIS) defines a fundamental dataset as one that cannot be derived from another dataset and is essential to the outcomes of a number of agencies.

Victorian policy delineates fundamental spatial data in the *Spatial Information Framework Information Guidelines* and *Spatial Information Business Information Guidelines* (Victorian Spatial Council, 2009a, 2009b). However, pricing is not based on this distinction. Rather, Victoria's pricing policies offer opportunity to apply differential pricing where the spatial data demonstrates public good characteristics. This is similar to the 'basic information set' defined in the Productivity Commission report *Cost Recovery by Government Agencies* and adopted by the Australian Bureau of Statistics for the release for statistical information for free online.

Despite differences around what is considered to be fundamental data, the datasets can be broadly categorised. Table 1 provides a possible classification that was drawn from the *Western Australian Land Information Authority Regulations 2007* and the schedule to the *Commonwealth Policy on Pricing of Fundamental Spatial Data*.

Table 1: Categories of fundamental data

Dataset	Description
Geodetic control	Location of geodetic survey marks
Topographic data	Basic topographic data including the Earth's surface and elevation
Property boundaries and tenure	Boundaries of lots (excluding details of strata arrangements) and unallocated Crown land Tenure data (data about ownership and vesting) for freehold and Crown land

Dataset	Description
Administrative boundaries	Boundaries of administrative areas including suburbs, localities and postcode areas Boundaries of maritime zones and the territorial sea baseline
Natural environment	Geo-referenced names of natural land features (including geographic features and conservation parks) Location and configuration of the coastal line
Transportation	Location and name of roads and tracks (including private)
Built environment	Geo-referenced names of built land features (including property addresses and names of administrative areas)
Aerial photography and satellite imagery	Aerial imagery of ground surface and satellite imagery

4 Spatial data industry in Australia and New Zealand

4.1 Industry definition

The spatial data industry produces and uses spatial resources and services. A report to the Spatial Education Advisory Committee, *The Spatial Information Industry in Australia* (2007) contains a more detailed definition:

> The modern spatial information industry acquires, integrates, manages, analyses, maps, distributes and uses geographic, temporal and spatial information and knowledge. The industry includes basic and applied research, technology development, education, and applications to address the planning, decision-making, and operational needs of people and organisations of all types.

The spatial data industry is a subset of the information technology sector and provides services to other industries including planning, natural resource management, engineering and health and emergency services.

The spatial data industry was not defined as a separate industry in the most recent Australian and New Zealand Standard Industrial Classification (2006). Activities of significant spatial resource providers are listed under 'Surveying and Mapping Services'.

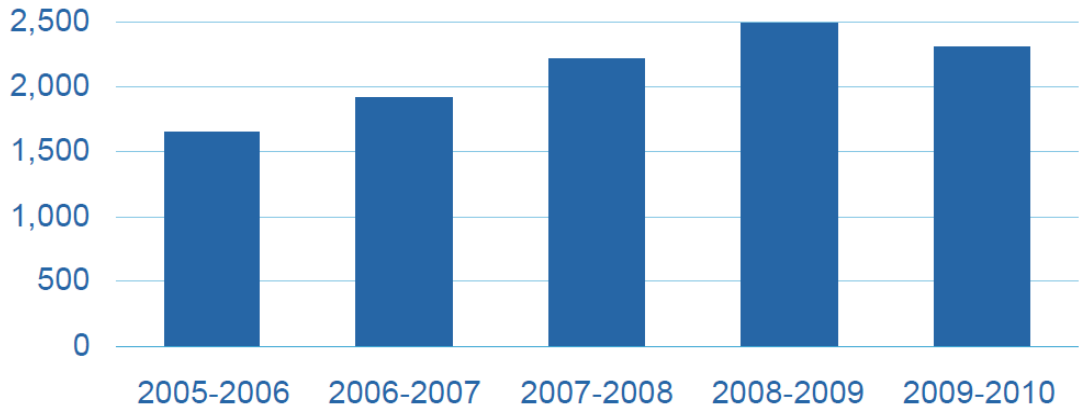
4.2 Industry size

Estimation of the size of the spatial data industry is a complex exercise. Many of the spatial resource companies classify themselves either broadly as information and telecommunication services or according to the industries they service. Furthermore, public and not-for-profit sectors are substantial participants in the industry and hinder accurate assessment of the whole of industry's size and impact.

Using National Accounts figures, ACIL Tasman (2008) conservatively estimated the size (revenue) of the private sector spatial data industry in Australia at $1.37 billion in 2006-07 with 750 spatial data businesses adding gross value of approximately $682 million. The GDP contribution of the private sector spatial data industry is estimated to be between $6.43 billion and $12.5 billion in 2006-07. For New Zealand, the GDP contribution in 2008 was estimated to be $NZ1.2 billion (ACIL Tasman, 2009).

ACIL Tasman's estimates for Australia are comparable to those of IBISWorld (Figure 2). In 2006-07 the industry revenue was estimated around $1.9 billion. According to a recent report by IBISWorld (2010), the private sector element of the industry has grown since. In 2008-09 the private sector earned revenue of approximately $2.5 billion with the industry gross product estimated at $1.5 billion. The sector comprises about 1,785 businesses and employs 12,500 people.

Figure 2: Industry revenue estimated by IBISWorld ($million)[4]



These industry size estimates underestimate the significance of the Australian spatial data industry as the underlying industry definition is narrowed down to the private sector only.

4.3 Value chain

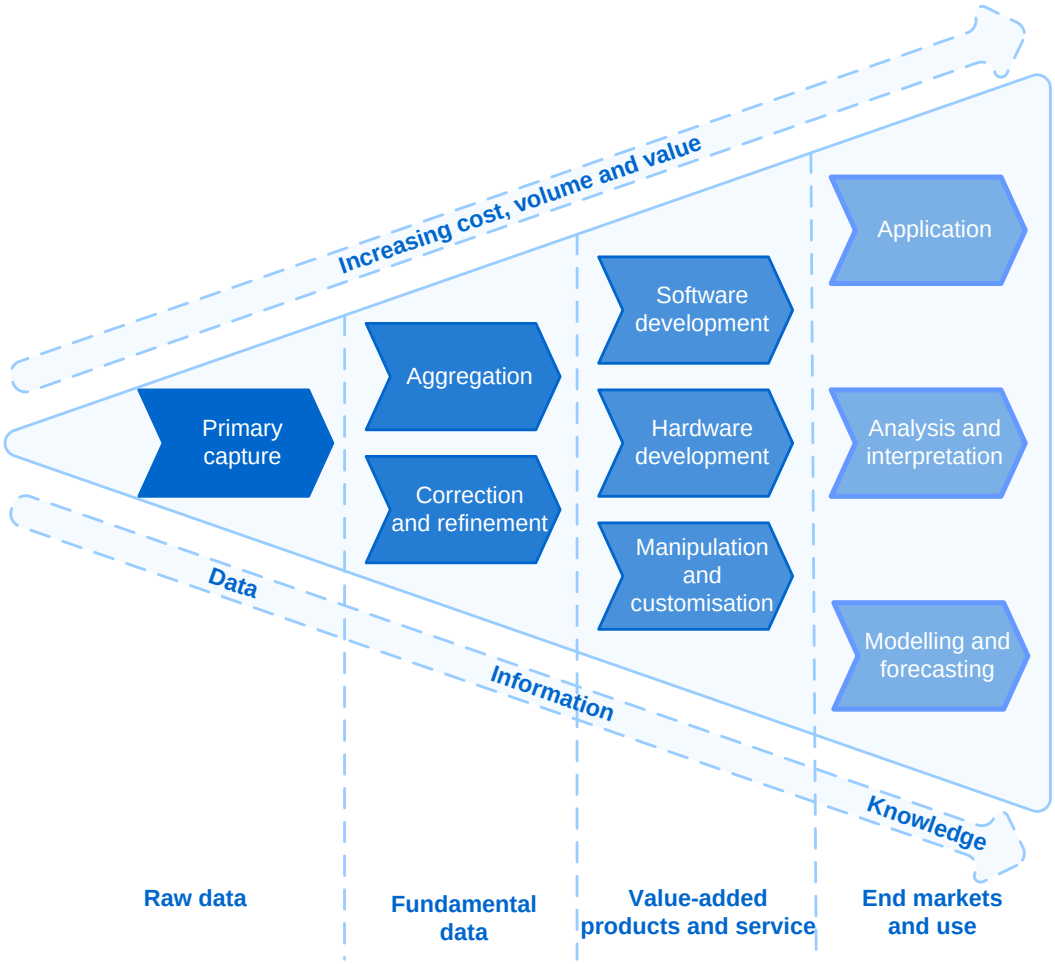
A value chain refers to a modification process of raw (collected) spatial data into final products and services that fit end user requirements. Each activity comprising the value chain can be performed by one or more participants of the spatial data industry.

[4] The 2009-2010 figure is a forecast.

4.3.1 Conceptualisation of the value chain

Different value chains have been proposed to reflect variable factors associated with the production and dissemination of spatial data. These variables include context, data attributes, currency, quality, accuracy and source (Longhorn and Blakemore, 2008). One conception of the value chain for spatial data is illustrated in Figure 3.

Figure 3: Value chain for the spatial data industry in Australia



The value chain demonstrates processes involved in the transformation of raw data into integrated business solutions. Value and production costs increase progressively as the data flows though the chain. Numerous customised products may be based on one fundamental dataset, thus, spatial data may be captured once but used many times.

For example, once collected, topographic data, land boundaries or street address data may be transformed in a number of products. This data may be customised to produce topographic tenure and cadastre or integrated with other datasets (e.g. places of interest) to create a street directory. Through further processing, property reports and customised maps can be assembled. The data can be transformed into digital elevation models. These data products enable ‘knowledge’ services such as predictive modelling and forecasting.

While value is created at each stage of the chain, most of the total cost of producing a dataset is incurred during the initial data collection. These initial costs include “labour costs of measuring the data or capturing it from various data sources as well as the cost of data transformation, analysis, and modification” (Genovese et al, 2009).

The nature, cost and players at each stage of the value chain has the potential for rapid change as technology evolves. Decreasing costs of production and an associated reduction in the natural monopoly characteristics of some parts of the industry are allowing new players to enter lower down the value chain. For example, improving accuracy of satellite technology is continuously enhancing data collection capability of private companies. The development of lower cost satellite technology is already underway.

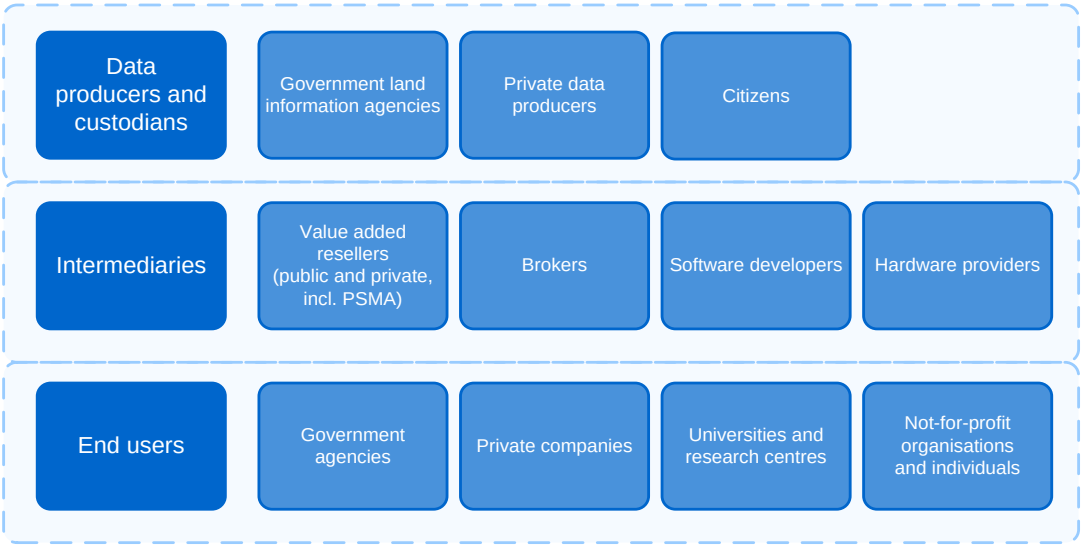
In the United Kingdom the private sector is already competing with the public sector land information provider (Ordnance Survey) in most areas of data provision, including addressing mid-scale road data and large scale topography in selected urban areas (Department of Communities and Local Government, 2009).

Additionally, user generated content is providing an alternative means of data generation. For example, Google partially mapped the United States road network using user-generated content for its Google Maps and Google Earth products. Improvements in information technology are rapidly changing the range of applications and end uses for spatial data, increasing the number of players in producing value added services and the volume of end users utilising products enabled by spatial data.

4.3.2 Industry participants along the value chain

The spatial data industry comprises government departments and agencies, universities and other not-for-profit institutions and private companies. Spatial data industry participants are illustrated in Figure 4.

Figure 4: Spatial data industry participants in Australia



The remainder of this section describes each of these industry participants.

Data producers

Data producers collect raw data at the beginning of the spatial data value chain. Most data producers also undertake some level of processing and value adding before selling or providing the products to intermediaries or end-users. Three classes of data producers are considered below; government land information agencies, private data producers and citizens.

Government land information agencies

All levels of government collect and process spatial data. The Australian state and territory governments create administrative data such as property and locality boundaries, as well as data on natural and physical features. The spatial data produced by Commonwealth government agencies tends to reflect the Commonwealth's responsibilities, such as natural resource management and environmental protection, and its ability to produce national datasets. PSMA Australia, owned by the Commonwealth and Australian states and territories also produces national datasets from state and territory data. In New Zealand, the national government creates administrative data and produces data reflective of its responsibilities for areas such as environmental protection and emergency management.

Most of the fundamental spatial data produced in Australia is collected, maintained and distributed by the state and territory government land information agencies in collaboration with custodian agencies[5] and other data suppliers. Data managed by other entities, such as local authorities, corporatised utility businesses (water, gas, electricity) and various state government agencies, may also be used to produce state-wide datasets. These entities may collect spatial data to support decision making as a by-product of the entity's functions or as a direct function of the entity.

In Western Australia, Landgate (a statutory authority) is responsible for managing fundamental data. In Victoria, Spatial Information Infrastructure in the Department of Sustainability and Environment holds this function. Source data are collected from a range of authorities such as local government, and compiled into 10 Vicmap products. At the national level, PSMA Australia facilitates integration of fundamental datasets from data supplied by Commonwealth, state and territory data custodians.

[5] Custodians are defined as entities charged with the responsibility of maintaining a specific data set to an agreed quality standard on behalf of the central land information agency.

The core state and territory land information agencies are listed in Table 2. Most, if not all, have the legislative authority to supply spatial data at prices to recover costs or commercial prices.

Table 2: State and territory government land information agencies

State/Territory	Land information agency
NSW	Land and Property Management Authority
Vic	Spatial Information Infrastructure, Department of Sustainability and Environment
Qld	Land Management and Use Division, Department of Natural Resources and Water
WA	Landgate
SA	Division of Environmental Information, Department of Environment and Heritage
Tas	Information and Land Services Division, Department of Primary Industries, Water and Environment
ACT	ACT Planning and Land Authority (ACTPLA)
NT	Land Information Division, Department of Planning and Infrastructure

For the Commonwealth, Geoscience Australia collects and provides a wide range of spatial data and products to the government and private sector. These include digital topographic and geological maps, elevation models and maps of Australia's maritime boundaries and the seabed. This data supports government functions such as natural resource management and environmental protection and enables response to emergencies caused by natural disasters and onset hazards (Geoscience Australia, 2010).

Geoscience Australia is the parent agency of the Office of Spatial Data Management which coordinates the implementation of the Australian Government's Policy on Spatial Data Access and Pricing.

Land Information New Zealand (LINZ) is New Zealand’s government department responsible for providing core geographic data to the public. The department supplies data about land titles, geodetic and cadastral survey systems, topographic and hydrographic data and maps. In 2007 LINZ established the Geospatial Office to ensure an integrated approach to geospatial data management and achieve better access to national geospatial data.

Private data producers

While most fundamental spatial data are collected by the public sector, this is beginning to change with private data producers progressively entering this segment of the value chain. The ability of the private sector to produce spatial data is driven by advancing technology, particularly improving satellite and imagery processing software capabilities, which is reducing the natural monopoly characteristics of spatial data. The launch of Geoeye 1 and Worldview2, satellites with the capability for almost daily repeat imaging, are illustrative of this trend (Department of Communities and Local Government, 2009).

Other examples include Nearmap, which collects imagery of Australia cities using aerial technology. The maps are updated monthly and can be traced over time. Intermap Technologies has developed an elevation model of the entire United Kingdom. It has sold digital elevation data to governments and private sector players throughout the United Kingdom (Intermap Technologies 2002, 2004). The implications of technological change in the production of spatial data by the private sector are discussed further in section 7.3.

Citizens

With the growing availability of spatial technologies to the general public, many governments, businesses and organisations are harnessing the ability of citizens to generate spatial data. This may involve volunteers submitting information generated by their global navigation satellite system units or allowing them to edit maps or add features of interest.

As an example, the United States Geological Survey (USGS) runs a program called *The National Map Corps* that uses volunteers to identify and locate map features and submit the data online (USGS, 2008). This improves the currency and quality of the USGS's National Map product. Another example is OpenStreetMap, a project to create a free editable map of the world that is based largely on ground surveys performed by volunteers with global navigation satellite system units.

Intermediaries

A range of intermediaries typically operate between the data producer and the end user of the spatial data. These may be value added resellers, data brokers or a range of software and hardware producers.

Value added resellers (VARs)

VARs add features to existing data and data products through value adding activities such as processing and incorporation into other data sets. Value can be generated by integrating and customising datasets to create a product that meets specifications of an individual end user and through data integration with software and hardware products.

Most VARs in Australia are private businesses. These range from small local enterprises with less than 10 employees to large international corporations. VARs can also be government owned businesses. For example, Landgate carries out value added services, such as its production of customised imagery and layered map products.

PSMA Australia is a state, territory and Commonwealth government-owned business that performs the functions of a VAR. The company assembles national fundamental spatial datasets from jurisdictional data supplied by State and Territory land information agencies and some Commonwealth agencies (i.e. Australia Post, Australian Electoral Commission and Australian Bureau of Statistics). PSMA Australia returns revenue to the States and Territories by way of royalties (PSMA Australia, 2009). The data from these organisations enables PSMA Australia to produce, for example, the Geocoded National Address File, which contains all valid physical addresses in Australia linked to their specific latitude and longitude.

Although PSMA Australia is government-owned, its activities are fully funded through revenue generated from data licensing and data supply agreements. PSMA Australia's pricing policy aims to cover existing costs and provision for projected future activities without creating a barrier to access. It acts as a 'wholesaler' to the private sector,

distributing its national datasets to other VARs and brokers. There is no price discrimination between the public and private sectors, with all purchasers required to obtain the PSMA Australia's products through brokers or other VARs.

Brokers

Brokers are individuals and companies that provide advice and source data for end users. Brokers maintain access to data and data products collected and owned by the public and private providers and VARs. Brokers often offer complementary services to their client, such as consultancy, research, software, risk and valuation solutions.

Software developers

Software developers provide software programs and applications that contain a spatial data component and enable use of the data. These include geographic information system (GIS) software, image-processing applications for satellite imagery and aerial photography, spatially enabled databases and application programming interfaces (that allow applications to interact and share data).

Hardware providers

Hardware providers offer a range of hardware systems for spatial data industry professionals and the general public. These include computers, notebooks and mobile hand-held devices, including personal digital assistants, global navigation satellite systems (GNSS) units and mobile phones. Paired together, hardware and software comprise spatial information systems. Examples of hardware providers include Tom Tom, a manufacturer of navigation devices and owner of map producer Tele Atlas; Garmin, a developer of GNSS systems; and Nokia, a mobile phone producer and owner of Navteq.

End users

Government agencies

Public sector agencies and local governments are major users of spatial data. Spatial data are used to support service delivery, planning and policy formulation. For example, the Bureau of Rural Science uses spatial data to prepare national land, vegetation and marine maps that subsequently inform activities of the Bureau. For State and Territory governments spatial data are used in policy development and implementation in areas such as urban planning, land allocation and management, emergency services response and crime prevention. Agencies charged with the responsibility of industry and state development are also large users of spatial data. In some instances data are acquired by agencies for 'government use' but the beneficiaries of the data include private firms.

Private companies

Private companies extensively use spatial data for various commercial purposes. This includes companies from a broad range of sectors such as mining, information technology, real estate, transports, agriculture and forestry. For example, resource companies use spatial data to enable mineral discovery and to establish production processes.

Universities and research centres

Universities and research centres may use spatial data for both commercial and non-commercial purposes. The data may be used for public research and teaching activities, including training of spatial sciences professionals. Universities and research centres may also use the spatial data in private research that benefits the entity funding the project.

A number of universities are actively involved in spatial data research through their participation in projects coordinated by the Cooperative Research Centre for Spatial Information (CRCSI). These include Charles Sturt University, Curtin University of Technology, Queensland University of Technology, University of Melbourne, the University of New England and the University of New South Wales.

Not-for-profit organisations and individuals

Spatial data are used by not-for-profit organisations and individuals. Charities and foundations may plan community services based on geographically referenced social and economic data. Environmental organisations use it to monitor and assess effects of human activities using spatial data such as aerial imagery of forested areas. Individuals and organisations also use spatial data to participate in and influence government decision making and policy development.

4.4 Peak bodies and governance organisations

A number of peak bodies are involved in the spatial data industry. These include government bodies such as ANZLIC – The Spatial Information Council, the Office of Spatial Data Management and the Australian Government Information Management Office (AGIMO), industry organisations such as the Spatial Industries Business Association (SIBA), the hybrid research orientated Cooperative Research Centre for Spatial Information (CRCSI) and a number of state based spatial organisations comprising both public and private participants.

ANZLIC – The Spatial Information Council

ANZLIC is the peak intergovernmental organisation for providing leadership in the collection, management and use of spatial resources in Australia and New Zealand.

ANZLIC develops and promotes adoption of nationally-agreed policies and strategies within Australia and New Zealand. Policies and guidelines are developed in collaboration with both public sector agencies and private sector enterprises and are based on international best practice.

ANZLIC is overseen by a Council that consists of 10 senior officials from the Australian and New Zealand Governments and the States and Territory governments of Australia (ANZLIC 2010).

Office of Spatial Data Management (OSDM)

The OSDM resides within Geoscience Australia described in section 4.3.2. The OSDM coordinates implementation of the *Commonwealth Policy on Spatial Data Access and*

Pricing (2001) across Federal Government agencies. The Policy seeks to improve accessibility to public sector spatial resources and supports the development of a private sector spatial data industry in Australia. The Commonwealth Policy is discussed in further detail in section 5.2.

The OSDM represents the Australian Government's interests in spatial resource coordination and access arrangements with the States and Territories and promotes efficient use of Australian Government spatial resources (OSDM, 2007).

Australian Government Information Management Office (AGIMO)

AGIMO, based within the Commonwealth's Department of Finance and Deregulation, promotes the greater use of information and communication technology by Australian Government agencies to improve government processes, including service delivery. AGIMO provides policy advice to guide investment, procurement, security and other aspects of information and communication technology application. AGIMO is also responsible for implementing the recommendations of the Review of the Australian Government's use of information and communication technology.

AGIMO has developed guides for the distribution of spatial data on the internet (AGIMO, 2008) and will lead the work program arising out of the Commonwealth Government's response to the Government 2.0 Taskforce Report.

State based peak bodies

A number of Australian states have peak bodies that comprise partnerships between public and private sector participants in the spatial data industry. Examples include the Victorian Spatial Council, the Western Australian Land Information System (WALIS) and the Queensland Spatial Information Council (QSIC).

The Victorian Spatial Council is a spatial organisation for business, government and research institutions. The Council is responsible for policies and standards for spatial resources, including the development of the Victorian Spatial Information Strategies.

WALIS is a partnership of government agencies, business, education and community groups that is responsible for coordinating access to and delivery of spatial resources held by Western Australian government agencies. Pricing of and access to spatial data in Western Australia is guided by the cabinet approved WALIS Pricing and Transfer Policy.

The QSIC consists of members from the private sector, natural resource management groups, universities and government. The QSIC aims to ensure that spatial data are accessible and that the collection, management and use of Queensland's spatial resources are optimised.

Cooperative Research Centre for Spatial Information (CRCSI)

The CRCSI, the peak research organisation for the spatial data industry in Australia, was formed in 2003 as part of the CRC Program initiated by the Commonwealth Government (CRCSI, undated).

The CRCSI is an unincorporated joint venture comprising over 100 participants from the private, government and academic sectors. Small to medium-sized enterprises are core

participants in the CRCSI and are represented through 43pl (43 Pty Ltd), a company established to engage and effectively manage their participation in the CRCSI. 43pl's representation has grown from 43 initial members in 2004 to around 70 members in early 2010 (CRCSI, 2010).

The CRCSI fosters research and development that would improve existing technologies or result in new applications, software and spatial products for remote sensing, surveying and geodesy. CRCSI is currently conducting research programs that deal with integrated positioning and mapping systems, metric imagery as a spatial data source, spatial information system design and spatial infrastructure, earth observation for natural resource management, modelling and visualisation for spatial decision support and demonstrators. CRCSI also performs contract studies for third parties.

CRCSI seeks prospective application of its programs and considers this potential when selecting and funding its activities. Licensing arrangements and royalty structures are prescribed in agreements between participants (where appropriate). The structure of the organisation makes it possible for research and development to be carried out jointly with subsequent commercialisation of the research to be undertaken jointly or separately.

CRCSI delivers short industry courses and provides scholarships and student support through its educational program. CRCSI also provides data for schools and the community as well as offers online education courses through its CRCSI Educational Portal.

Spatial Industries Business Association (SIBA)

SIBA, established in 2001, is the peak private sector organisation for the spatial data industry in Australia and has recently been established in New Zealand.

SIBA represents over 500 small to medium-sized participants on issues specific to the spatial data industry (SIBA, 2009). In recent years these have included water policy, climate change, national security, privacy, emergency management, transport policy, space industry policy, infrastructure development, the National Spatial Data Infrastructure, the National Digital Elevation Framework and industry skills development. SIBA aims to raise the spatial data industry's profile and enhance awareness among the community of the industry's contribution to the national development. The Association also advocates for the core spatial resources collected by all levels of government to be made readily accessible and available to the community at the cost of transfer.

5 Pricing of and access to spatial data in practice

This chapter reviews the pricing and access policies for fundamental spatial data in Australia and internationally. For Australia, the policies for the Commonwealth, Victoria and Western Australia are examined in detail. The policies in place at a national level in the United States, the United Kingdom, Canada and New Zealand are also considered.

Chapter 8 provides an assessment of the Australian pricing and access policies.

5.1.1 Chronology of policy developments

The pricing and access policies in effect in Australia and New Zealand have been influenced by a number of competing factors and policy decisions. Table 3 summarises some of these policy decisions and reports.

Table 3: Past policy decisions and reports relating to pricing and access to spatial data

Date	Event	
Apr 1995	Competition Principles Agreement	Agreement between the Commonwealth, States and Territories agreeing to a range of competition principles including competitive neutrality, reform of structural monopolies and prices oversight.
Apr 2000	Western Australian Land Information System (WALIS) Pricing and Transfer Policy approved by Cabinet	Establishes pricing policy of cost recovery for commercial uses and pricing at the cost of extraction and distribution for non-commercial users where there is no contestable market for the product
Aug 2001	Productivity Commission Inquiry into Cost Recovery	Found that many aspects of cost recovery arrangements lack the attributes of good policy and are inconsistent with sound economic principles. Recommended defining basic product set based on public good characteristics, positive spillovers and other Government policy reasons that should be funded from general taxation revenue.
Sep 2001	Commonwealth Policy for Spatial Data Access and Pricing	Policy provides for fundamental spatial data to be provided free of charge over the internet and at no more than the marginal cost of transfer for packaged products.
Jul 2005	Australian Government Cost Recovery Guidelines released	Cost recovery should be applied where it is efficient to do so. Products and services funded through the budget process form a basic information set and should not be cost recovered. Criteria for taxpayer funding should be that the data has public good characteristics, they generate significant spillover benefits or there are other Government policy reasons.
Oct 2005	Government Information Licensing Framework (GILF) project commences (incorporating work since 2004)	Program initiated by the Queensland Spatial Information Council to encourage use and re-use of public sector information. GILF provides seven licensing options, including six Creative Commons licences that are the preferred method of licensing for government intellectual property.
Dec 2005	Announcement all statistical information on Australian Bureau of Statistics (ABS) website free	ABS provides “basic information set” using criteria in Australian Cost Recovery Guidelines as basis for releasing all information on the website free of charge.

Date	Event	
Nov 2006	Land Information Authority Act (WA) passed	Act established Landgate and the pricing regime for fundamental spatial data in Western Australia. Effectively implements WALIS Pricing and Transfer Policy
Sep 2007	Victorian Government Cost Recovery Guidelines published	User charges should be set on a full cost recovery basis because it ensures that both efficiency and equity objectives are met.
Feb 2008	Pollock et al, *Models of Public Sector Information Provision via Trading Funds* published	Report commissioned by United Kingdom Department for Business, Enterprise and Regulatory Reform and HM Treasury finds that for five of six trading funds examined, including Ordnance Survey, it is socially optimal to price fundamental data at marginal cost (free online) and otherwise seek cost recovery
Jan 2009	National Geospatial Advisory Committee report The Changing Geospatial Landscape released	Analysis of United States geospatial data industry found government was shifting from being the primary provider of geographic data to a major consumer. Private sector and state and local government data provision had increased. The paper recognised a need to re-examine the relationship between data providers and users as the existing arrangements no longer reflect the marketplace.
Jan 2009	President Obama issues Memorandum on Transparency and Open Government	Presidential memorandum requiring government departments to take actions to implement the principles of transparency, participation and collaboration. The launch of data.gov followed.
Jun 2009	Inquiry into Improving Access to Victorian Public Sector Information and Data reports (Government response Feb 2010)	Concluded that no cost or marginal cost pricing for a basic information data set is most effective to achieve economic efficiency. The basic information data set includes information products possessing public good characteristics, positive spillover effects, or other public policy purposes. Otherwise, cost recovery pricing is appropriate.
Dec 2009	Government 2.0 Taskforce report	Taskforce concluded that the most economically efficient price to make PSI available to others is the marginal cost of doing so. PSI should be free, based on open standards, easily discoverable, understandable, machine-readable, freely reusable and transformable. The Taskforce considered that open access will enhance accountability of government and elsewhere, can increase productivity, and allows community participation.
Apr 2010	Ordnance Survey releases OS OpenData	Following consultations, Ordnance Survey moves from a full commercial pricing model to opening up a broad range of spatial data for free online to increase innovation and support the Government's Making Public Data Public Initiative.
May 2010	Australian Government response to Government 2.0 Taskforce report	The Australian Government response accepts in principle most recommendations of the Taskforce, with implementation subject to passage of information reforms.

5.2 Pricing and access policies in Australia

Australian jurisdictions have adopted a range of different pricing and access policies. Some of the most common forms of pricing for spatial data are:

- *Full cost recovery*: price is determined with regard to all costs attributed to data production, including collection, processing, maintenance and distribution. All costs are fully distributed across the range of spatial data products and services.

- *Commercial pricing*: pricing reflects full cost recovery plus a commercial mark-up, representing a profit or surplus component.

- *Marginal cost pricing*: price is equal to the cost of supplying an extra unit of a good or service. It represents only the variable costs of production and approximately equates to the cost of extraction and distribution. The marginal cost of extraction and distribution for one additional customer is effectively zero for data supplied online (although some policies define extraction and distribution to include a share of overheads).

- *Avoidable cost pricing*: price is equal to the costs that would be avoided if production (or distribution) of a particular output was ceased. It includes all variable costs plus a share of fixed costs attributable to the production and supply of a data set (infrastructure, corporate overheads etc). The share is defined by the costs that would be avoided.

To illustrate the difference between marginal and avoidable cost, consider a decision to provide a product (that is already in existence) online to a class of customers. The avoidable cost is the cost of providing that online service, such as the cost of new storage capacity or bandwidth. Once the product is available online, the addition of *one* more customer would not increase the level of cost, making the marginal cost effectively zero. Marginal cost would equal the avoidable cost if only one additional customer were to access the product once it was made available online.

The main distinguishing difference between the jurisdictions is the extent of price differentiation between customer classes and the degree of cost recovery. Some jurisdictions adopt full cost recovery for supply to commercial end users, with fundamental data for non-commercial uses provided at a price reflecting the avoidable or marginal cost, or free of charge.

The variety of pricing policies implemented results in a similarly diverse range of licences being applied to spatial data. Typically, where pricing is above marginal cost, restrictions are placed on distribution and re-use, with royalty payments required for revenue obtained from commercial use of the data. Marginal cost pricing attracts more liberal licensing, such as the Creative Commons suite of licences. Creative Commons is a non-profit organisation that has built a range of free licences that allow content owners to specify which rights they retain in their works and which rights they will waive. The licences are designed to facilitate the distribution, re-use and remixing of intellectual property.

One of the drivers of these distinctions is differences in the type of spatial data collected. For example, the Commonwealth collects spatial information on more of a project basis than the states and territories, with data collected for projects having lower or negligible maintenance requirements. This influences the nature of the costs incurred and the value of the spatial information to consumers.

5.3 Analysis of pricing and access policies

The Commonwealth, Victorian and Western Australian Governments have well developed pricing and access policies for spatial data. The pricing and access policies of the other jurisdictions might be considered less developed or in a state of change. This section reviews the policies of the Commonwealth, Victorian and Western Australian Governments, the objectives behind these policies and their implementation.

Table 4 summarises the pricing and access regimes for these jurisdictions.

Table 4: Pricing and access policies for fundamental spatial data of the Commonwealth, Victorian and Western Australian Governments

	Commonwealth	Victoria	Western Australia
Policy enshrined in legislation?	No	No	Yes - *Land Information Authority Act 2006*
Publicly available pricing and access policy documents	Commonwealth Policy on Pricing of Fundamental Spatial Data	Victorian Spatial Information Strategy 2008-2010 Spatial Information Pricing and Licensing Guidelines, 2nd Edition Spatial Information Pricing Methodology Spatial Information Access Guidelines - Second Edition Cost recovery guidelines Competitive Neutrality Guidelines	Pricing and Transfer Policy for Land and Geographic Information held by Western Australian State Government Agencies (Cabinet policy) Landgate Strategic Plan 2008/09-2012/13
Stated policy objectives	Maximise the net benefits to the community The purpose of the policy is stated to be to provide a whole of government approach to pricing fundamental spatial data, which ensures efficient and effective use of resources and maximises the economic and social benefits	Prices should not be an impediment to use Revenue obtained from distributing spatial data should be used to maintain and develop it to the standard required by users	To perform functions related to spatial data on a basis that does not involve making a profit To generate for the State a fair commercial return from providing goods and services on a basis that may involve making a profit
Scope of fundamental data	Schedule of Australian Government Spatial Data (160 datasets) Auxiliary List (1412 datasets)	Victorian Spatial Council *Spatial Information Framework Information Guidelines* (termed framework information)	Land Information Authority Regulations (2007)
Non-commercial pricing (including inter-department)	Online – free Packaged - price not exceeding marginal cost of transfer Customised - price not exceeding full cost of transfer	Cost recovery pricing (plus competitive neutrality adjustment where significant business) unless: (a) there is not a business, in which case supply at the cost of delivery (this test applies to the activity of the Victorian Government) (b) specifically exempted by Treasury or where explicit policy or public good reasons (c) where a price set in statute or regulation Full cost includes maintenance, future development but excludes capital costs and cost of associated statutory process	Price to recover extraction and provision costs, including a proportion of overheads required to provide the service A non-government organisation must be approved as non-commercial, which requires that the person: (a) has functions of a public nature (b) will not use the data for purposes other than education, research or activities of a community or regional nature; and (c) will comply with the conditions on which the data are supplied

	Commonwealth	Victoria	Western Australia
Commercial pricing	As for non-commercial use	As for non-commercial use	Price to recover total costs plus a surplus
Licensing regime	Copyright maintained. Acknowledgment of copyright required and must absolve Commonwealth from liability arising out of use of data. Required to report value adding	Documented commercial use and licensing arrangements. Internal use licensing for inter-departmental data transfer	Range of licences varying by customer and use
Royalties	None on online or packaged products. May be royalties on customised products	Apply to commercial exploitation of data to sell new, or value added, products and services that will return a revenue stream.	Royalty attached to value added reseller licence, commission payable under broker licence
Restrictions on re-use	Generally none where supplied over internet or as packaged product. May be restrictions on use of customised products	As per commercial use and licensing arrangement	As per licence - generally restricted

5.3.1 Commonwealth pricing and access policies

The Commonwealth's pricing policy for spatial data was set out in 2001 in the *Commonwealth Policy on Pricing of Fundamental Spatial Data*. The *Commonwealth Policy on Access to Fundamental Spatial Data* was also adopted in 2001.

Objectives

The objective of the Commonwealth's pricing and access policy is stated to be maximisation of the net benefits to the community. It is considered that this is best achieved through a whole-of-government approach across Commonwealth Government agencies to pricing fundamental spatial data, ensuring efficient and effective use of resources and maximising the economic and social benefits (Commonwealth Interdepartmental Committee on Spatial Data Access and Pricing, 2001).

Pricing

The *Commonwealth Policy on Pricing of Fundamental Spatial Data* seeks to make all fundamental spatial data freely available at the marginal cost of transfer. All federal agencies are to make their fundamental spatial data available online, which implies that the marginal cost of transfer approaches or equals zero. Where distributed as customised products, distribution is to be at the full cost of transfer.

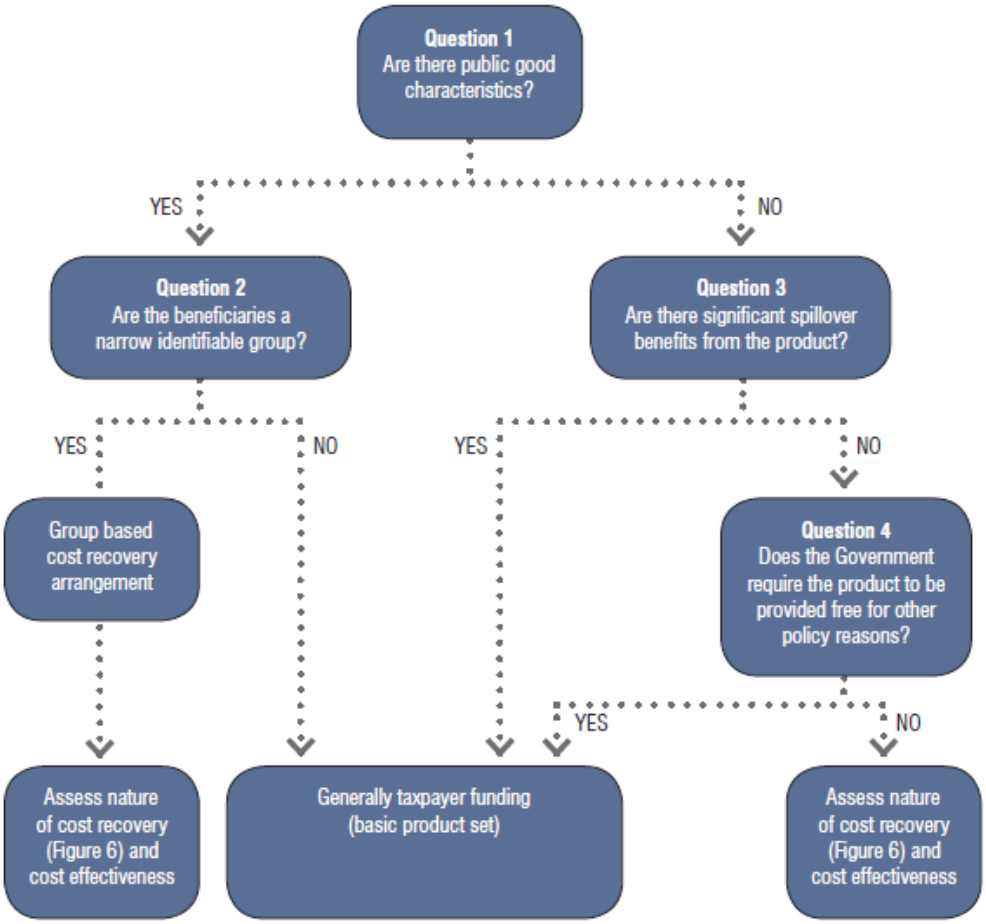
Fundamental data available under the policy is listed in the *Schedule of Australian Government Spatial Data*, which as of April 2010 consisted of 160 datasets. Further datasets available under similar conditions but subject to some constraints are listed on the Auxiliary List, which listed 1412 datasets in April 2010. An example of a dataset on the Auxiliary List might be a dataset sourced from a number of sources, as result of

which the Commonwealth is not the sole intellectual property owner and is unable to supply in accordance with the policy.

The *Commonwealth Policy on Pricing of Fundamental Spatial Data* effectively takes the position that all fundamental spatial data sets held by the Commonwealth satisfy the definition of the basic product set and should be taxpayer funded. The concept of a basic product set is set out in the Productivity Commission report *Cost Recovery by Government Agencies* (2001) and in the Australian Government *Cost Recovery Guidelines* (2005).

The *Cost Recovery Guidelines* set out three criteria under which data should be taxpayer funded as it falls within the basic product set: where the data has public good characteristics, where there are significant positive spillovers and where there are other policy reasons for taxpayer funding. The decision tree in the guidelines that is recommended as a tool for assessing whether cost recovery should be applied is shown below in Figure 5.

Figure 5: Australian Government Cost Recovery Guidelines – Assessing Funding for Information Products (Commonwealth of Australia, 2005)



In 2005-06, the last year for which expenditure data are available, Commonwealth Government agencies expended $86 million on spatial data management. Revenue of $4.4 million was received from the sale of this data, of which $0.9 million related to

datasets that were listed in the *Schedule of Australian Government Spatial Data* (OSDM, 2007).

Access

The *Commonwealth Policy on Access to Fundamental Spatial Data* states that copyright is to be maintained but re-use is to be allowed with acknowledgement of copyright and absolution of liability. There are no restrictions on commercial use or value added activities relating to fundamental spatial data. There are also no royalties to be paid for the use of online or packaged products. Royalties may be applied in the case of customised products.

Given the Commonwealth's liberal licensing regime for fundamental spatial data, there has been a move towards the use of Creative Commons licences. In November 2009, Geoscience Australia officially adopted Creative Commons Attribution as the default licence for its website (Geoscience Australia, 2010). This follows adoption of Creative Commons licences as standard practice in the Australian Bureau Statistics (ABS 2009b) and for water information in the Bureau of Meteorology (BOM, 2010).

5.3.2 Victoria's pricing and access policies

The Victorian Spatial Council's *Spatial Information Pricing and Licensing Guidelines* were first released in August 2006 as part of the *Victorian Spatial Information Strategy 2004-2007*. A second edition of the guidelines was released in January 2010, as part of Victoria's Spatial Information Management Framework.

The guidelines draw on two other policy documents that predate the guidelines. The Victorian Government's *Cost Recovery Guidelines* state that "general government policy is that … user charges should be set on a full cost recovery basis because it ensures that both efficiency and equity objectives are met". User charges are also subject to competitive neutrality considerations, as required under the *Competitive Neutrality Policy*, with adjustments for competitive neutrality applied where there is a significant business. In such a case, pricing may be on commercial rather than cost recovery basis.

Objectives

The Victorian Spatial Council's *Spatial Information Pricing and Licensing Guidelines* refers to two principles on which the pricing is based:

- Prices should not be an impediment to use.
- Revenue obtained from distributing spatial data should be used to maintain and develop it to the standard required by users.

These over-arching principles support other objectives such as maximising the benefits of government spatial data by maximising access to it and facilitating the greatest possible use of spatial data. However, there is a natural tension between these principles, as is discussed in more detail below.

Licensing objectives are set around maintaining control of the spatial data and commercial considerations. These include:

- managing intellectual property
- addressing liability issues
- promoting client loyalty and confidence in ongoing supply
- protecting revenues to ensure appropriate funding for maintenance
- compliance with competitive neutrality principles.

Pricing

Cost recovery is the default pricing approach for spatial data in Victoria, with the Victorian Spatial Council's *Spatial Information Pricing and Licensing Guidelines* directly reflecting the Victorian Government's *Cost Recovery Guidelines*. This cost pricing approach is consistent with the objective that revenue should be used to maintain and develop spatial data to the standard required by users.

The *Cost Recovery Guidelines* and the *Spatial Information Pricing and Licensing Guidelines* note that there are a number of principles that cost recovery arrangements should meet. Cost recovery should:

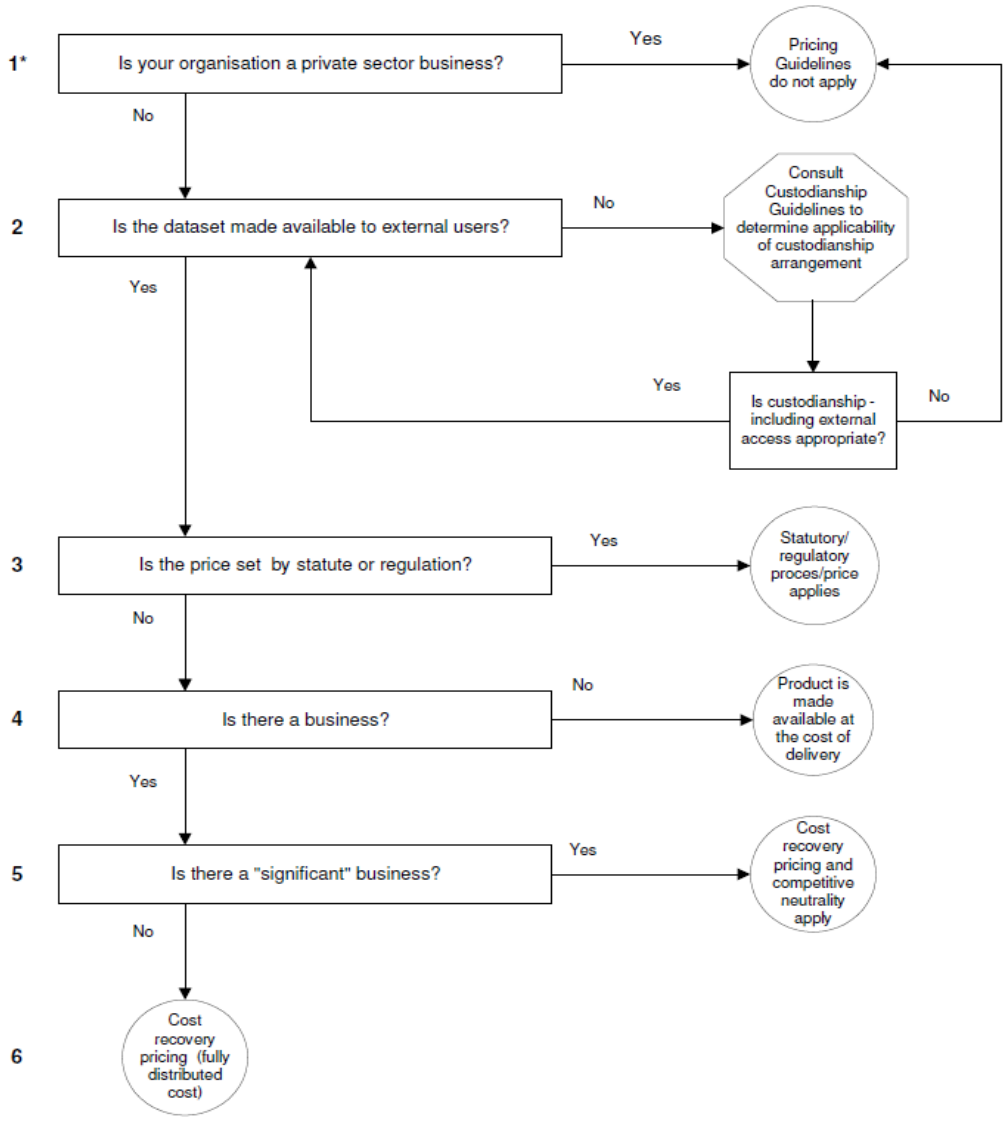
- be consistent with the objectives of efficiency, equity and fiscal sustainability and with other policy objectives such as competition and innovation
- be imposed directly on those who benefit from provision of the good or service
- be cost effective and practical
- be feasible and legal.

Cost recovery may not be applied where:

- there is an explicit policy reason
- required by legislation
- there is not a "business". The assessment of whether there is a business applies to the activities of the Victorian Government agency, with the main indicator that the sale of spatial data is not a "business" being that the agency receives full service funding through the State budget. The definition of a business has its foundations in competition policy, with the potential for user charging required for there to be a business.

To determine the pricing approach, the decision tree is Figure 6 is applied. The decision tree applies filters according to whether there is a business and according to competitive neutrality principles. The questions as to whether the organisation is a private sector business and whether there is a business apply to the organisation supplying the spatial data, which will generally be the Victorian Government agency.

Figure 6: Victorian Spatial Council decision tree for determining a pricing approach for spatial resources



While full cost recovery is the default, cost recovery may not be applied due to an explicit policy reason. Such a reason may arise due to the economic characteristics of the pricing information. The *Spatial Information Pricing and Licensing Guidelines* set out a series of economic characteristics related to the public good characteristics of the data and the positive externalities that the good may generate. Based on these characteristics, a decision may be made to not apply cost recovery. These characteristics are set out in Figure 7.

Figure 7: Economic Characteristics of Government Goods and Services for consideration of whether full cost recovery is appropriate (Victorian Spatial Council, 2010)

		Examples	Pricing approach
Pure public goods	Non-excludable and non-rivalrous, ie consumption and the benefits arising from it are available to the community as a whole	National defence Street lighting	Funded by the community as a whole through general taxation
Selective public goods	Beneficiaries are specific groups	Strategic research that benefits a particular industry group	User pays
Club goods	Where people can be excluded from the benefits they provide, but where use by one person (within the 'club') does not detract from its use by another	National parks	User pays
Private goods	Consumption is by one party only, and where benefits only accrue to the consuming party	Birth Certificate	Full cost recovery
Merit goods	The community as a whole desires a higher use of the good or service than would be likely if it were charged at full cost.	Education Health Care	Less than full cost recovery
Goods that generate *positive externalities*	Consumption of certain goods and services by individuals may generate external benefits to unrelated third parties	Preventative health care eg vaccinations	Less than full cost recovery

The use of these characteristics to identify and release fundamental spatial data in Victoria at less than full cost recovery has been limited. It is more of a theoretical construct as opposed to being referred to routinely in practice.

Victorian pricing policy does not explicitly discriminate on the basis of proposed use. There is no explicit process for differentiating commercial and non-commercial users, with both being generally subject to the same method for determining price. There are some arrangements where non-commercial users receive discounted products. As local councils provide their sub-division data to Spatial Information Infrastructure, they receive free access to Vicmap products as it relates to their area. There are licences for research and education, such as with Landcare and universities. However, these non-commercial arrangements are made on a case-by-case basis and there is no clear process for discounting.

Approximately $3.5 million is raised from the sale of spatial data in Victoria annually, with budget costs associated with collecting, maintaining and distributing the data of approximately $14 million.

Access

Victoria applies a range of different licences and conditions contingent on the data set, although in all cases, re-use is restricted. Under many of the licenses, royalties are applied to commercial uses. Any commercial exploitation of data to sell new or value added products and services that will return a revenue stream attracts a royalty.

5.3.3 Western Australia's pricing and access policies

In Western Australia, the pricing regime for the State's fundamental data is covered by the Cabinet endorsed WALIS pricing and transfer policy. For commercial use, the policy requires cost recovery, with pricing to recover the costs of extraction and distribution and a proportionate share of the costs of data capture and maintenance. Non-commercial users are to be charged the cost of extraction and distribution where there is not a contestable market for the product. The Commonwealth government is to be treated as a private sector user for the purposes of the policy.

Pricing for fundamental spatial data held by Landgate is set out in the *Land Information Authority Act 2006.* Landgate is a statutory authority with specific objectives defined in its legislation, which differentiates it from the other Australian land information agencies. The Act contains both Landgate's objectives and the pricing principles under which fundamental spatial data must be priced for commercial and non-commercial uses. The pricing principles in the Act fit broadly within the WALIS pricing and transfer policy, but contain more detail specific to Landgate.

The remainder of this section focuses on the objectives and policies of Landgate.

Objectives

Landgate's objectives as set out in the *Land Information Authority Act 2006* are:

- to act as a body through which the State performs certain functions related to spatial data on a basis that does not involve making a profit
- to generate for the State a fair commercial return from providing goods and services on a basis that may involve making a profit.[6]

These objectives reflect Landgate's role as a statutory vehicle for supplying some services on a non-commercial basis to meet public policy requirements while reserving the right (and expectation) to generate a surplus on some goods and services. Thus, price discrimination is integral to Landgate's objectives.

Further principles under which Landgate is to operate are also set out in the Act. The Authority is required to act in a cost effective manner and act on prudent commercial principles. Landgate also has to perform its functions under the Act in a way that supports the sustainable economic, social, and environmental management and development of the State. It should have regard to the importance of satisfying the

[6] *Land Information Authority Act 2006*, section 8

spatial data needs of the State government and the requirements of participants in the spatial data industry within the State.[7]

Pricing

The *Land Information Authority Act 2006* states that where goods or services are provided for any purpose that involves a commercial benefit being derived, pricing is to provide Landgate with an overall profit representing a fair commercial return after covering the total costs related to the goods and services.[8]

In cases where no commercial benefit is to be derived, fundamental spatial data can be provided to the State or a local Government organisation for the cost of extraction and provision of the data. This cost of extraction and provision includes a proportion of the cost of accommodation, equipment and other overheads required to provide the service. On approval by Landgate, other parties may obtain fundamental spatial data for the cost of extraction and provision if they satisfy a number of criteria in the *Land Information Authority Act*.[9] To obtain approval, Landgate must be satisfied that the person to whom the data is provided:

- has functions of a public nature
- will not use them other than for the purposes of education, research, or activities of a community or regional nature
- will comply with any conditions on which the goods or services are provided.

Landgate maintains a schedule of non-commercial entities that are entitled to exemption from full cost pricing for fundamental spatial data. This schedule consists exclusively of government bodies. Non-government organisations seeking discounted access are assessed on a case-by-case basis for each application for data.

For the purposes of pricing, fundamental spatial data are considered to consist solely of the data sets prescribed by the Land Information Authority Regulations 2007. This list sits alongside the Landgate definition of fundamental datasets as those datasets that are essential to the outcomes of a number of government agencies, and cannot be derived readily from another dataset, although there are some departures from that definition (Landgate, undated).

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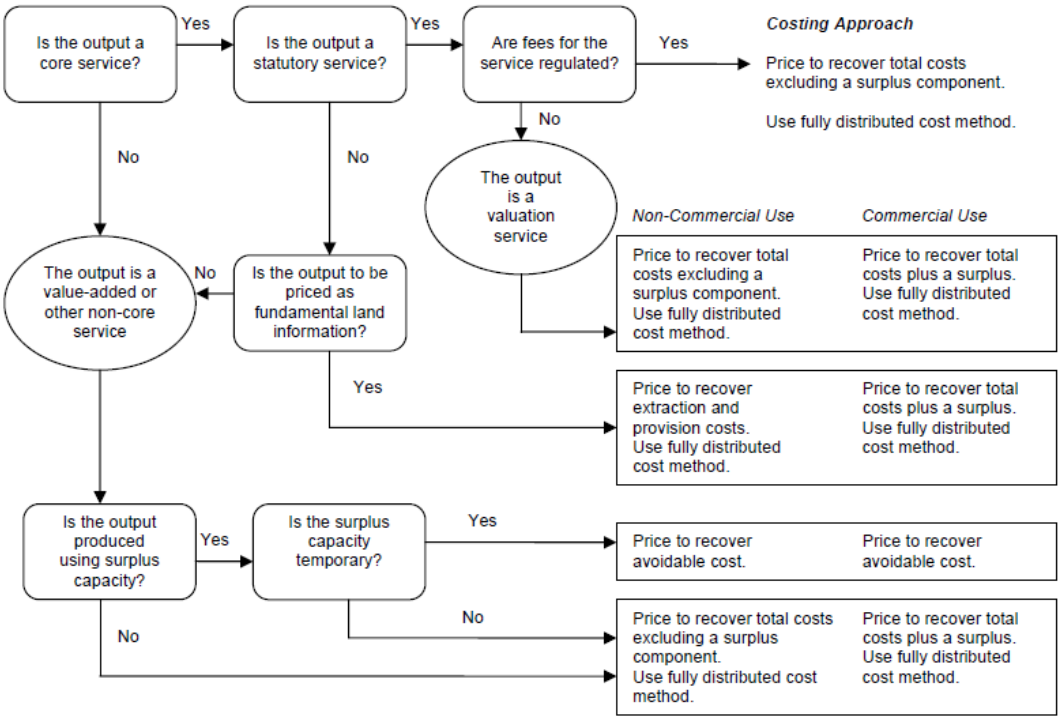
[7] *Land Information Authority Act 2006*, section 10

[8] *Land Information Authority Act 2006*, section 16(3)

[9] *Land Information Authority Act 2006*, section 16(9)

Figure 8 indicates the decision tree Landgate utilises in pricing spatial data products. As for Victoria, regulatory services are distinguished. However, Western Australia also explicitly distinguishes fundamental data as part of its pricing process.

Figure 8: Landgate pricing decision tree (Landgate, 2008b)



Landgate's legislative framework is reflective of the Western Australian Department of Treasury and Finance's guidelines *Costing and Pricing Government Outputs*. These state that "fees and charges should be set at a level that reflects the full costs of providing these services, unless Government approves otherwise." (Department of Treasury and Finance, 2007)

In *Costing and Pricing Government Outputs* it is noted that there are circumstances where cost recovery may not apply. In deciding whether full cost recovery should be sought, the guidelines note that the reason for provision of the service, such as natural monopoly characteristics in the industry, public good characteristics of the good or service and the presence of positive externalities, and competitive neutrality should be considered. In the case of natural monopolies, pricing should be set as if there was a competitive market. For public goods and with positive externalities, full cost recovery may mean that too little of the good or service is consumed. Landgate's ability to discount for non-commercial uses may be based upon such considerations, although public good and other characteristics are not explicitly to be considered under the *Land Information Authority Act*.

One of Landgate's distribution channels is the Shared Information Platform (SLIP). SLIP provides an online environment for accessing spatial datasets through a single portal. The pricing policy for data accessed over SLIP is still being developed, with consideration being given to subscription and download fees.

Approximately $5 million revenue is obtained annually through the sale of spatial information by Landgate, of which approximately $1.5 million comes from fundamental spatial data sales.

Access

Landgate applies a range of different licences and conditions to access to spatial data. This is contingent on the data set, although in all cases re-use is restricted. Under many of Landgate's licenses, royalties are applied to commercial uses. Value added resellers pay a royalty, while brokers pay a commission.

5.3.4 Australian pricing policy developments

While the pricing and access regimes for fundamental spatial data are well established for the Commonwealth, Victoria and Western Australia, a number of recent inquiries have put forward arguments and recommendations for increasing the availability and reducing the price of public sector information, including spatial data.

Government Information Licensing Framework (GILF)

GILF is a program initiated by the Queensland Spatial Information Council to encourage use and re-use of public sector information. This was to be achieved by assisting information providers in making licensing decisions, reducing legal risk and by making public sector information searchable and useable (Queensland Government, 2010). The Queensland Government is currently undertaking consultation as to adoption and the final form of the GILF policy.

GILF provides seven licensing options, including six Creative Commons licences that are the preferred method of licensing for government intellectual property. It is proposed that all intellectual property be licensed under the GILF licences.

Consideration has also been given to adoption of GILF in other jurisdictions and agencies, such as through the GILF for the Nation Project and GILF for Water project. The GILF for the Nation Project, which ran between May 2008 and April 2009, sought to make available the Queensland GILF framework across all jurisdictions. A work plan approved by the Cross Jurisdictional Chief Information Officers Committee, comprising the Chief Information Officers of the States and Territories, provided for the development of a website and other material to enable the GILF framework to be validated in each jurisdiction. The tools developed during the GILF for the Nation Project form part of the toolkit for implementation of the Government 2.0 Taskforce recommendations relating to licensing.

Creative Commons

Creative Commons is a non-profit organisation that has built a range of licences that allow content owners to specify which rights they retain in their works and which rights they will waive. The organisation was formed due to concerns that copyright law as practiced was cumbersome and limiting the potential for creation and innovation.

Under the licences, the user is generally free to share (copy, distribute and transmit the work) and to remix (to adapt the work), subject to a number of conditions that vary depending on the specific Creative Commons licence chosen. The licences are specifically tailored for use in Australia under Australian copyright law (Creative

Commons Australia, undated). There is no charge for the use of the licences. There is no general prohibition on charging for products distributed under these licences unless it is specifically prohibited such as the Creative Commons Attribution Non-Commercial licence.

The Australian Bureau of Statistics, Geoscience Australia and the Bureau of Meteorology use Creative Commons licences for some of their material.

Victorian Parliamentary Inquiry into Public Sector Information

The Victorian Parliament's Economic Development and Infrastructure Committee's *Inquiry into Improving Access to Victorian Public Sector Information and Data* contained recommendations on the pricing of the government's basic information set. The Victorian Government has given in principle support for the recommendation that all data determined to form part of the Victorian Government's basic information product set be either provided free of charge or at marginal cost. It was noted, however, in the government's response (Government of Victoria, 2010) that this would be subject to a number of conditions such as inter-departmental agreement and the nature and expense of servicing current and foreseeable information demands.

Although spatial data was considered in the report and was the basis for some of the case studies used as examples, the recommendations did not differentiate spatial data from other forms of public sector information. It is unclear what the practical implications of the implementation of the recommendations in relation to the pricing of fundamental spatial data will be.

The inquiry used the definition of "basic information product set" used by the Productivity Commission in its 2001 report *Cost Recovery by Government Agencies*. The Productivity Commission definition is based on public good characteristics, spillover effects and other government policy reasons. This is in some sense similar to Victoria's current pricing criteria of spatial data, which includes public good characteristics and positive externalities (spillover effects) as criteria in deciding whether all costs should be recovered. However, the set of information released for free or at marginal cost under Victoria's current pricing and access policy is limited.

Government 2.0 Taskforce

The Commonwealth's Government 2.0 Taskforce was established in June 2009 to advice and assist the Government to, among other things, make government information more accessible, useable, consultative, participatory and transparent. The scope of the report included all public sector information.

The Taskforce delivered its report to the Australia Government in December 2009. It recommended that, by default, public sector information should be:

- free in the absence of substantial marginal costs
- based on open standards
- easily discoverable
- understandable
- machine-readable

- freely reusable and transformable.

To encourage free and open reuse and adaptation of this information, it was recommended that the Creative Commons Attribution Licence should be the default licence.

The report also recommended that the Australian Government should engage other State and Territory governments to extend these principles into a national information policy that operates at all levels of government.

In May 2010, the Australian Government's response agreed in principles with the above recommendations (Australian Government, 2010). The implementation of these recommendations is to be done through the Freedom of Information reforms contained in the *Freedom of Information Amendment (Reform) Act* 2010 and the *Australian Information Commissioner Act* 2010, and the Attorney General's Department ensuring that the Governments Intellectual Property Guidelines do not impede the default licensing position.

The Taskforce made a number of observations concerning charging for public sector information. Firstly, it was noted that the economic activity stimulated by the release of the information may generate more taxation revenue than sales revenue is lost, particularly when the transaction costs of administering a pricing and licensing regime are included. Where this is not the case, a more phased budget approach might need to be adopted. It was also noted that increased revenue from economic activity would not be received by the agency that formerly charged for the information. The Taskforce recommended work by the lead agency to deal with these issues to move towards a marginal pricing regime and remove constraints to information access.

The Taskforce also encouraged greater examination of the costs and benefits of releasing public sector information. This may lead to clearer establishment of the case for selling public sector information such as the ability for free products to stimulate more sales of complementary products.

5.4 International pricing and access policies

5.4.1 United States

The collection and distribution of spatial data in the United States is undertaken by the United States Geological Survey (USGS). Products produced by the USGS include thematic data, topography and aerial imagery. The USGS's National Mapping Division is bound by Federal Government pricing guidelines to distributing electronic information at no more than the cost of reproduction (equivalent to the cost of extraction).[10] Fundamental spatial data are available online free of charge to both end users and value added resellers with an unrestricted license.

The quality of available fundamental spatial data varies in terms of its currency and geographic coverage. The primary output of the agency is a national topographic map. This product is provided at a 1:24,000 scale and is on average 20 years old, with data for

[10] United States Code, Title 44, Chapter 19

New York 29 years old, Los Angeles 16 years and Chicago 24 years (Ordnance Survey, 2008). Attempts to improve the currency and quality of the government's spatial data have been hindered by insufficient funding. The thematic data are generally more up-to-date as it is a statutory requirement to provide data for natural resource management and response to emergencies caused by natural disasters. However, it is mostly collected only for specific areas and when required.

Government funding is used to cover the costs of collecting and maintaining the datasets. This is relatively inexpensive as data are neither detailed nor up-to-date for both rural and metropolitan areas (Ordnance Survey, 2008).

State mapping agencies and local authorities produce large scale datasets that are generally commercially priced.

Under these policies, an active private spatial data industry has developed, with the Geospatial Information and Technology Association estimating that the geospatial sector is increasing at 35 per cent per year, with the commercial side increasing at 100 per cent per year (NGAC, 2009).

The Federal Government purchases high quality spatial datasets from private sector providers. These data are restricted by intellectual property rights and cannot be re-distributed freely. This limits the government's ability to maintain its own up-to-date data products, as well as its ability to make available the data to other users. The government has become a coordinator or manager rather than a data producer (NGAC, 2009), with the private sector playing a greater role in the spatial data industry in the United States than in other countries. The ability to integrate mapping data from various sources into one consistent national dataset has diminished. For example, the US Census Bureau did not have access to existing commercial data on the street networks from Navteq and TeleAtlas (private sector data providers) to prepare for the 2010 Census (NGAC, 2009). A duplicated version had to be assembled from datasets of more than 4,000 local governments, with the data often found to be incompatible or unavailable because of local licensing policies or it did not exist.

In January 2009 the Obama administration announced a *Transparency and Open Government* initiative aimed to improve openness, transparency and accountability of the government. As part of the initiative, an on-line searchable data catalogue *(Data.gov)* was launched in May 2009, including spatial data resources. The key objective of the portal is to improve public access to high value and machine readable datasets and facilitate the creative use of those datasets.

5.4.2 Canada

Collection and distribution of spatial data is undertaken by Natural Resources Canada. Fundamental datasets produced include thematic data, small scale topography and aerial imagery. As in the US, the main objective is the collection of thematic data.

Canada has adopted the US approach to pricing and access of spatial data. Until 2007, Canadian agencies priced fundamental spatial data to recover a portion of costs. However, in April 2007 the fees were abandoned and the data was made available free of charge to all users with an unrestricted licence. As a result, the volume of downloads of spatial data increased from 100,000 datasets in 2006-07 to 5.4 million datasets in 2007-08 (Ordnance Survey, 2008). The data are provided through a single portal to both end users and value added resellers.

As is the case in the US, the topographic data offered in Canada is typically dated. For example, in 2008, Canada's National Topographic Data Base had not been updated for 12 years for Ottawa, for 20 years for Montreal and for 16 years for Vancouver. However, the recent move to a free distribution model indicates that currency was an issue under the partial cost recovery model.

Federal government funding is used to cover the costs of collecting and maintaining the datasets.

State mapping agencies and local authorities produce large scale datasets that are generally commercially priced.

5.4.3 United Kingdom

In the United Kingdom, fundamental spatial data (and a large proportion of value added products) is produced and supplied by Ordnance Survey, the national mapping agency. Ordnance Survey is structured as a trading fund (equivalent to a statutory authority with commercial trading powers) and has historically received no government funding.

Until 2010, the majority of Ordnance Survey data were commercially priced and available for purchase by both end users and value added resellers. The data were supplied at a discount to the central and local governments through specific arrangements.

The main commercial product supplied is a large scale (1:1,250) product that comprises large scale topography, aerial imagery, the transport network, addresses and postal codes. Some free products were also available, such as small scale online maps, map products for education and "OS OpenSpace", an application programming interface for non-commercial use by web developers.

Both large and small scale data are updated every 6 to 12 months. The Ordnance Survey's commercial profitability had provided for the funding of high quality spatial data. It has been generating its revenue from data licensing, with a majority of revenue generated through sales of high specification products to customers.

On 31 March 2010, it was announced that from 1 April 2010 a range of Ordnance Survey products would be available free for use and re-use, including commercial re-use (OS OpenData) (Figure 9). This followed consultations around three potential models: keeping the self-funded licensing model; releasing licensing constraints on large scale data or a staged transition to the second option (Department of Communities and Local Government, 2010).

Figure 9: OS OpenData products

The range of products released for free use as part of OS OpenData is:

- OS Street View, a 10,000 scale raster product
- 1:50,000 scale gazetteer
- 1:250,000 scale colour raster
- OS Locator, a searchable gazetteer of road names
- Boundary-Line, administrative and electoral boundary data at a nominal scale of 1:10,000
- Code-Point Open, which provides the location of postcode units
- Meridian 2, a mid-scale digital representation of the UK
- Strategi, a detailed digital map derived from 1:250,000 scale topographic database
- Miniscale, a 1:1,000,000 scale raster product
- OS VectorMap District
- Land-Form PANORAMA, a 1:50,000 digital height product.

As part of the announcement of the release of OS OpenData, it was stated that the government had negotiated a commercial agreement with Ordnance Survey for the licence to OS OpenData and for its ongoing maintenance. While the details of the commercial agreement are not public, consultation around the release of free data estimated lost revenue of between £19 million and £24 million per annum (although this was for a slightly different collection of products to those actually released). Provision of the free datasets was expected to result in avoidable costs of £6 million to £8 million per annum for the next five years (Department of Communities and Local Government, 2009). Ordnance Survey's Non-Executive Chairman noted that:

> The launch of OS OpenData has been made possible because of the Government's commitment to providing ongoing funding to support this data package, in order to ensure a sustainable Ordnance Survey for the future … This is fundamental to maintaining the quality of the data for which Ordnance Survey is globally renowned (Margetts, 2010).

In a lead up to changes in Ordnance Survey's pricing and access policy, the Pollock Review assessed impacts of various pricing models for provision of the public sector information on performance of UK's six largest trading funds. The study formulated a socially optimal pricing policy: pricing fundamental data at marginal cost (free on-line) and leaving the charging regime for other products unchanged, i.e. at cost recovery (Pollock, 2008). The overall net benefit of this policy was estimated to be between £85 million and £156 million.

5.4.4 New Zealand

In New Zealand fundamental spatial data are predominantly supplied by Land Information New Zealand (LINZ). Products produced by LINZ include topography and aerial imagery.

A cost recovery model was formerly in place in New Zealand. However, since 2000 the New Zealand government has been moving towards providing free or marginal cost access to spatial data. For example, prior to 2000 the 1:50,000 topographic map series was priced at $NZ1 million; subsequently the price was reduced to $NZ1,500. Since September 2009 the 1:50,000 topographic map series has been distributed for free online, with the topographic database available for purchase for $NZ84. LINZ distributes for $NZ53 the survey quality data used to create the country's Landonline database (LINZ, 2010). The fees are reflective of whole of government policy (designed to recover distribution costs, but not production and maintenance costs) rather than decided independently by LINZ.

There are no royalty payments for users wishing to value add and on-sell the data. Data are priced at the cost of dissemination. Licensing is limited to acknowledgement, with purchasers able to on-sell and share with no additional payments required.

LINZ sells predominantly to value added resellers who subsequently provide the data to the public and private sectors. Other public and private sector participants can also purchase it directly from LINZ.

Both small and large scale data are available as it is a statutory requirement to provide data required by the Defence Ministry and the Emergency Services, with LINZ's main purpose to provide this data (Ordnance Survey, 2008). The large scale is updated frequently as it is used for the cadastre. The 1:50,000 topographic map series is updated once a year for populated areas.

The New Zealand government funds the costs of collecting and maintaining the datasets. The costs are higher than those in Canada or the United States but the data quality is also higher (Ordnance Survey, 2008).

Despite availability of fundamental data at price well below its full cost, utility companies typically perform their own surveys to obtain more complete datasets as the government data are focused on meeting the needs and requirements of the Ministry of Defence and the Emergency Services (Ordnance Survey, 2008).

The reductions in prices by LINZ are in accordance with the 2005 and 2008 Digital Strategies that aimed to provide easy access to the public sector information (Ministry of Economic Development, 2008). The trend of making spatial data available at marginal cost is continuing, with the July 2009 announcement by the Ministry for the Environment that two environmental databases (the Land Cover Database and Land Environments New Zealand) would be made available online, for free and licensed under an unrestricted Creative Commons licence.

6 Pricing and access objectives and principles

There are a number of guiding principles for developing an effective pricing and access framework for fundamental data. Application of the principles may conflict, depending on the primary objective of the pricing and access regime. Therefore, the choice of pricing approach, and the relative weight given to each principle, will be influenced by the objectives and outcomes being sought.

This chapter sets out:

- a number of possible objectives of the pricing and access regime for fundamental spatial data
- guiding principles that should be considered in developing a pricing and access approach that meets one or more objectives.

6.1 Pricing and access objectives

It is important to be clear about the objectives of pricing and access as this will shape the form of approach. Typical objectives of a pricing and access regime are as follows:

- promotion of economic development
- facilitation of effective public policy decision making and efficient delivery of government services
- generation of revenue and/or a return on investment
- government accountability
- promotion of competition by addressing anti-competitive pricing and access
- protection of privacy and national security
- restriction on access for pricing purposes.

Each objective is discussed in further detail below.

6.1.1 Economic development

A primary objective of most pricing and access policies is to promote economic development. Spatial data has significant economic effects and is an important enabler of business activity. One estimate of the industry gross value added of the Australian spatial data industry was $682 million (ACIL Tasman, 2008).

An objective of maximising the economic benefit of spatial resources requires a number of considerations to be balanced. These considerations include, but are not limited to:

- pricing in an efficient manner
- the level of funding
- the quality and level of 'fit for purpose' of the fundamental spatial data
- the level of dissemination and use.

6.1.2 Public policy support

Fundamental spatial data forms a core component of public policy decision making. Access to high quality spatial data can support effective decision making in government. It is estimated that 80 per cent of government data has a spatial element (Martin 2008). Spatial data are effectively 'soft infrastructure' that enables the functioning of government decision making in an informed manner.

Government is a major user of spatial data in the delivery of government services. Uses include emergency services, government owned utilities and urban services such as waste collection.

Fundamental data that is primarily used for public policy and government services may be undersupplied in a market as the benefits cannot be captured through property rights. A purchaser will be unwilling to pay a price corresponding to the total value that the data creates because much of the benefit accrues to parties other than the purchaser. In such circumstances, the price purchasers are willing to pay will not accurately signal the value of the data and there may be a role for government to supplement supply.

If spatial data are available to the government agency that collected it but is not available to another part of government for decision making or service delivery due to pricing or access barriers, this is sub-optimal compared to when all parties have access. However, this is contingent on initial production of the data, which may depend on price signals as to the value of that data.

6.1.3 Generation of revenue

Generation of revenue and / or a commercial rate of return on the investment in spatial data are often core objectives of pricing and access policies. There is seen to be a public interest in the production of spatial data being funded by those who directly use it and an interest in obtaining a return on taxpayer investments. Revenue objectives are also linked to objectives to maintain and develop spatial data to a standard adequate for users and to achieve an economically efficient level of production through pricing signals. Principles concerning equity are also a common rationale for revenue generating objectives.

An objective of revenue generation forms a core component of pricing policies in Victoria and Western Australia. For example, the *Land Information Authority Act (WA)* states that one of Landgate's objectives is to "generate for the State a fair commercial return from providing goods and services on a basis that may involve making a profit". Landgate's Strategic Business Plan objectives contain targets for profit and return, and an objective of paying dividends to government by 2012-13.

6.1.4 Accountability

Access to public sector information, including spatial data, can contribute to enhancing accountability in government, and potentially more broadly. This information can be used to facilitate participation in public policy decision making, allow advocacy in relation to policy decisions and provide a base from which individuals can participate in decision making in both the public and private spheres. This can contribute to better decisions and government policy outcomes being shaped by the needs of citizens (Deloitte 2010).

An objective of accountability was also a main driver of the Government 2.0 Taskforce (2009). Greater access to data can lead to improved service delivery, improve the responsiveness of the public sector and involve communities in decision making.

Another element of accountability in government relates to the objective of maintaining internal discipline in producing services to a level and standard that is efficient and not wasteful of public expenditure. User-pays pricing of government services can assist with promoting this form of accountability as it encourages agencies to focus on those services that customers want, as signalled by their willingness to pay the costs of service delivery.

6.1.5 Promotion of competition

Competition is a primary driver of efficiency and innovation. In a competitive market, participants must adopt the lowest cost technologies and are incentivised to develop new low cost methods of production. Over the long run, this leads to a reduction of costs and prices across the industry.

The application of appropriate pricing and access principles can facilitate competition by pricing goods competitively and applying the principles of competitive neutrality. Appropriate pricing by government can alleviate competition issues associated with pricing of a good with natural monopoly characteristics. Competitive neutrality involves adjustment of prices for the advantages and disadvantages that a public body has due to the nature of government ownership. The application of competitive neutrality can prevent the crowding out of private sector participants by the government.

6.1.6 Protection of privacy and national security

Access policies for spatial data are often designed to effectively protect the intellectual property in the spatial data and to maintain a level of control as to its use. Access objectives also include protection of privacy and sensitive information that may relate to issues such as national security.

6.1.7 Restriction on access for pricing purposes

An objective of some access policies is to facilitate the implementation of pricing policies. At a basic level, restrictions on access can allow prices to be charged by creating exclusivity over the spatial data. A licensing regime can be used to apply differential pricing between customer types through controlling distribution of the data and the manner in which it is used.

6.2 Principles

6.2.1 There should be no hard constraints to access

Within the pricing framework, access to spatial data should be free of hard constraints (that is, non-price constraints) unless there is a strong reason to maintain restrictions on access (such as privacy or national security). It is commonly agreed among all of the Australian land information agencies that access to fundamental public sector spatial data should be facilitated and that they are best placed to distribute that data.

The presence of hard constraints prevents any social value from the use of the data being achieved. Hard constraints prevent the presence of signals regarding the value of the data and they decrease competition in the production of products using that data.

Hard constraints to access also include distributing spatial data to a select group as opposed to making the data generally available to any party on the same terms and conditions. Other potential hard constraints include data format and data delivery mechanisms.

The availability of spatial data itself to the community has benefits in that it facilitates engagement with government and provides citizens with resources to place pressure on governments to improve decision making processes. The form of pricing and access to public sector information will influence the level of participation by the community in the activities of government.

6.2.2 Pricing should promote efficiency

Governments should seek to achieve efficiency in the supply of spatial data.

Efficiency refers to the allocation of scarce resources in a way that maximises the benefits to society. Efficiency considerations include the provision of appropriate pricing signals to users to promote allocative efficiency; the public good characteristics of the data; the positive externalities generated by distribution; avoidance of duplication of effort where there are natural monopoly characteristics and incentives to minimise transaction costs.

Efficiency has a number of dimensions: allocative, productive and dynamic.

Allocative efficiency

Allocative efficiency is achieved when resources are allocated so as to maximise the net benefit from their use. It requires that a good or service only be produced if its value to users is greater than the cost of production. Allocative efficiency is achieved when marginal benefit equals marginal cost. In a market, this implies that price paid by the marginal consumer (the consumer who is willing to pay only the marginal cost), equals marginal cost.

However, where there are substantial fixed costs, pricing at marginal cost will under recover fixed costs. Pricing must be at least at average cost for the producer to recover costs. Marginal cost pricing does not ensure that goods are produced only where their value is greater than the cost of production.

Productive efficiency

Productive efficiency occurs when a good is produced at its lowest possible cost (given the production level of all other products).

In the presence of natural monopoly characteristics, productive efficiency implies that there is a single producer (see dynamic efficiency for qualifications on this point). Production by multiple parties results in duplication of the fixed costs and overall production costs being greater than they would otherwise be.

Dynamic efficiency

Dynamic efficiency occurs where resources are allocated so as to maximise the net benefit from their use **over time**, reflecting changing technology, demand and cost of production.

Allocative or productive efficiency at a point in time may not be dynamically efficient as the distribution of resources may have detrimental effects on long term efficiencies such as innovation and competition. The absence of appropriate pricing signals may also affect dynamic efficiency as production decisions will be required to be made without the information concerning the value of the resources that pricing provides.

For example, while productive efficiency of a good with natural monopoly characteristics implies a single producer, a single producer has less incentive to innovate or reduce costs due to the lack of competition. They may also choose to extract monopoly rents.

6.2.3 Pricing should be adjusted for public goods and spillovers

Government has a role to play in the provision of spatial data where there is a market failure, such as in the case of public goods or where there are positive externalities. Public goods and spillovers are defined in section 3.1. Spatial data exhibits public good characteristics and has positive spillovers. Where a good is a public good or has positive spillovers, pricing at the market price and restricting access (through licensing) will result in under-consumption of this data relative to the efficient outcome. If the government's objective is to maximise spillovers or community welfare from consumption of the data, lower prices will be required.

The public good characteristics and positive spillovers of public sector information and the pricing implications for that information have been reflected in a number of reports. The report by the Victorian Parliament's Economic Development and Infrastructure Committee (2009) references the Productivity Commission (2001) and argues that "public goods are not typically supplied by the private sector or, if so, they are supplied in insufficient quality. This is because the goods cannot be provided exclusively to paying customers and non-paying customers cannot be prevented from benefiting from them. Thus, it is a government responsibility to provide the public good."

Price differentiation between different user types or uses may also be used to maximise spillovers. Price differentiation involves pricing information at different prices for different consumers, potentially allowing for lower pricing to be applied for uses with large positive spillovers.

6.2.4 Pricing should facilitate equity

The pricing of and access to spatial data should be equitable.

Equity has two dimensions: horizontal equity and vertical equity. Horizontal equity is said to be achieved when those who benefit pay the associated costs. In the case of excludable goods, this distinction can normally be clearly made. Commercial users utilising fundamental data as a factor of production can be easily identified. However, where there are public good characteristics or significant positive externalities, delineation of who has benefited and how much they have benefited is more difficult.

Vertical equity is said to be achieved when those with the greater capacity to pay contribute more to cost recovery than those with lesser means. This is often achieved through price discrimination, such as offering certain non-commercial users a lower price.

6.2.5 Pricing should be consistent with competition principles

Pricing and access regimes for spatial data should be consistent with the basic principles of competition policy.

The Australian, State and Territory governments are signatories to the *Competition Principles Agreement* of 1995. These principles include prices oversight (particularly for monopoly or near-monopoly suppliers), competitive neutrality and structural reform of public monopolies.

Competitive neutrality requires that where governments operate in markets with private sector participants, they do so on an equal footing, meaning that any advantages or disadvantages conferred in a government agency by way of public ownership should be taken into consideration when determining price. In the presence of sound policy reasons, this requirement can be waived. Structural reform of public monopolies was concerned with the introduction of competition into areas of historical public monopoly

Prices oversight was concerned with ensuring that pricing by government business enterprises was done in an efficient manner. Features of effective prices oversight include:

- independence
- submissions by interested parties
- publishing of the pricing recommendations and reasons.

6.2.6 Pricing and access should be determined on a product by product basis

The balancing of the above principles is likely to vary from product to product. Different fundamental spatial data products will have differing level of public good characteristics and positive externalities, differing degrees to which the benefits are captured by different parties and varying levels in which it might contribute to public policy decision making or government accountability.

With this variation in attributes between fundamental spatial data products, it is unlikely that a uniform agency level pricing and access policy will be appropriate. Instead, pricing and access should be determined on a product by product basis. This is consistent with the Productivity Commission (2001) recommendation that “[c]ost recovery arrangements should apply to specific activities or products, and not to the agency as a whole”.

7 Issues

While each of the principles set out in the previous chapter are relatively uncontroversial in isolation, their application in practice raises a number of issues. This is because there are potential conflicting values and different objectives associated with the principles. There is therefore a need to weight the emphasis placed on each principle depending on the objectives sought.

This chapter contains a review of a number of issues that arise in the practical application of the principles to the pricing and access of fundamental spatial data. The discussion of each issue draws on views expressed by stakeholders in the consultation phase of this project and viewpoints presented in the literature. Some of the discussion in this chapter relates to stakeholder experiences with particular pricing and access models both in Australia and overseas.

Consistent with the aims of this study, the different views held by various parties are documented. Each section concludes with PwC's analysis of the points raised and a summary of the key points is provided. This analysis is performed with reference to the principles set out in the previous chapter.

7.1 Funding

Spatial resources are not recognised as infrastructure by government

Across all parties consulted, fundamental spatial data was seen as a special form of public sector information. It is generally developed for a purpose as opposed to being a by-product of government programs and processes. It is considered to be an authoritative source of information, with quality checking and standardisation carried out to allow it to fulfil this role. In this respect, fundamental spatial data acts as a form of 'soft infrastructure' to government, business and private individuals. Many stakeholders considered that spatial resources fulfil a role analogous to physical infrastructure such as roads.

Across most participants in the consultations, it was also considered that there is a lack of recognition by government of the 'soft infrastructure' role that spatial resources fill. A common example provided by stakeholders of this lack of recognition was the rejection by Infrastructure Australia of proposals for spatial information infrastructure funding.

Land information agencies expressed concern that this lack of recognition of the role of spatial resources as 'soft infrastructure' would lead to inadequate funding from government in the event of a move to a model in which fundamental data are provided free of charge. Reference was made to the decline in spatial data currency in the United States and the inability of the national government to quickly assemble quality datasets in times of national disaster.

Analysis

The perception of the role and importance of spatial resources by government has implications for the funding its production and management. A decision that pricing at less than cost recovery is optimal due to, say, the positive externalities and multiplier effects, must be matched by a decision to provide funding of a magnitude sufficient to provide the data and realise those positive externalities and multiplier effects.

Accordingly, suitable mechanisms to ensure adequate funding are required where the land information agency no longer has the ability to raise revenue itself.

Key points

- Stakeholders expressed concern that governments and treasuries do not fully appreciate and value the important role of spatial resources as ‘soft infrastructure’.
- Concerns were expressed that this lack of recognition would most likely lead to erosion of public funding for producing fundamental spatial data should land information agencies be required to supply data to all users at no cost.

The production, maintenance and supply of fundamental spatial data requires funding

All stakeholders consulted noted that the production, maintenance and supply of fundamental spatial data require a stable and certain source of funding. While collection costs are the most obvious, spatial data requires ongoing maintenance and updating to maintain accuracy and quality, together with costs for infrastructure upgrades, with these involving significant costs.

The funding for the production, maintenance and supply of fundamental spatial data may be sourced through payments from users, or from government appropriations. Direct government funding could ensure sustainability in the supply of spatial data. However, in the absence of recognition within government of the role of spatial resources as ‘soft infrastructure’, it was stated that fiscal sustainability may require some form of contribution by users. Many stakeholders noted that a natural implication of a failure to fund spatial resources is a reduction in the availability and quality of data.

A majority of respondents to the industry survey stated that the quality of fundamental spatial data was more important than price. This is in line with a view stated by the Department for Communities and Local Government (2009) in the United Kingdom, although the Department suggested that for end-users further down the value chain a very high degree of accuracy of spatial data is not seen as critical for use.

The views on the impact of funding on spatial data are also mixed. Although now somewhat dated, an international survey of spatial data users found those in the United States to be more satisfied and feel that more business opportunities result from the current geospatial environment than was the case in Australia (KPMG, 2001). Pollock et al (2008) suggested that a move to a publicly funded model (marginal cost recovery) should not have a detrimental effect on data quality providing there is suitable governance within the government agency.

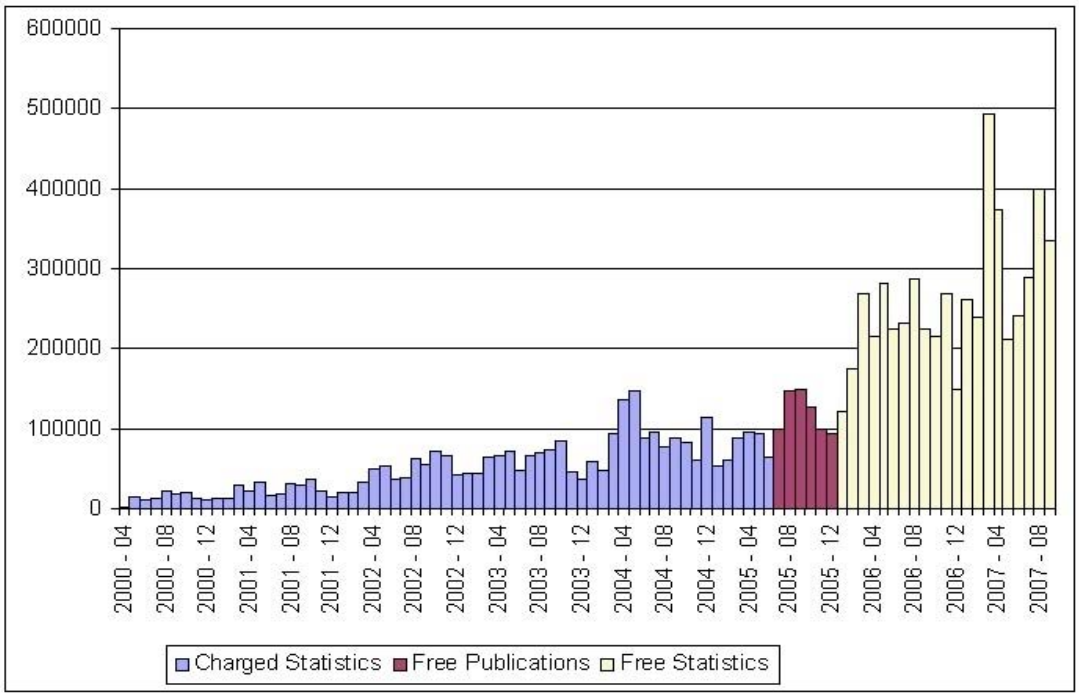
The evidence as to the funding effect of moving away from a user pays model in Australia is mixed. The announcements in June and December 2005 (Costello 2005b, 2005c) of the release by the Australian Bureau of Statistics (ABS) of statistical data free online was preceded by a funding boost in the May 2005 Commonwealth Budget (Costello, 2005a). One stakeholder suggested the ABS has more influence in obtaining budget than state land information agencies.

Australian Bureau of Statistics Case Study

In June 2005, the Commonwealth Treasurer announced that electronic copies of ABS publications and related statistical tables would be available free online (Costello, 2005b). This was funded from an additional $76.2 million over 4 years allocated to the ABS in the May 2005 Commonwealth Budget (Costello, 2005a). The range of products available for no charge was increased in December 2005 when, at the ABS's centenary celebration, the Treasurer announced that all material on the ABS website would be available free of charge (Costello, 2005c).

Following these announcements, the number of downloads from the ABS website significantly increased. Downloads increased from 963,000 in 2004-05 to 4,500,000 in 2006-07, the first full year of free downloads. The increase is shown in Figure 10.

Figure 10: Number of downloads from Australian Bureau of Statistics website (Fitzgerald, 2007)



Approximately $3 million in revenue was foregone by the ABS from the move to free online downloads. During the consultations, the ABS stated that the budget allocation in the 2005 budget and approximately $400,000 in saved administration costs left the ABS in a similar financial position to what it was before the policy change.

In the absence of pricing to obtain user feedback, the ABS draws on user and advisory groups, meetings with representatives of government agencies, forums involving non-government and/or government delegates and consultations to seek to ensure that ABS statistics meet user requirements. These include:

- the Australian Statistics Advisory Council, consisting of representatives from all state and territory governments and a range of members chosen to represent government, business, academic and community interests
- the State Statistical Forum, comprising the state and territory governments
- the Australian Government Statistical Forum, which encourages engagement between senior levels of Australian Government agencies
- over 70 subject matter or region specific user or advisory groups (ABS, 2009).

A number of stakeholders felt that there had been a decline in the quality of spatial data provided by Geoscience Australia since the implementation of the Commonwealth's free online pricing and access policy. For example, there were comments about the currency of Geoscience Australia's topographic maps. Some 1:50,000 maps date from 1970s and 1980s, potentially pointing to issues other than the Commonwealth pricing and access policies as the reason for the decline in currency, although some small scale topographic mapping is also now over 10 years old.

Commonwealth Pricing and Access Policy Case Study

Since the introduction of the Commonwealth's pricing and access policies for fundamental spatial data, the number of datasets delivered has undergone a significant increase. In 2001-02, 75,310 datasets were accessed under the policy. This increased to 219,821 in 2004-05 and 862,530 in 2005-06 (Pollock, 2008).

A review of the *Spatial Data Pricing and Access Policy* (DITR, 2004) noted that no further budget was made available to make up for the $1.3 million reduction in annual revenue between 2001 and 2003. The Office of Spatial Data Management decided against making a budget submission for the additional funding as it was considered unlikely to succeed.

In Canada and the United States (at the Federal level), which largely operate on a free distribution model, public topographic maps are heavily dated. In New Zealand an up-to-date 1:50,000 topographic map series is distributed for free online, with the topographic database available for purchase for $NZ84.

Analysis

Evidence linking pricing policy and data quality is mixed. Government spatial data at the Federal level in Canada and the United States is clearly outdated and although there is evidence of the private sector filling this gap, funding has not been available for the government to provide up-to-date data. Other jurisdictions such as New Zealand and agencies such as the Australian Bureau of Statistics have continued to maintain their data at a similar quality, although with much larger level of distribution.

Key points

- Under any pricing policy, a certain level of funding is required to produce, maintain and distribute the spatial data that the agency wishes to produce.
- The evidence concerning the funding constraints and effect on data quality where a marginal cost of free pricing regime is adopted is mixed.

There are alternative paths to fiscal sustainability

A number of stakeholders questioned whether a cost recovery or cost plus pricing approach is the optimal path to fiscal sustainability for land information agencies. This is particularly the case in the digital marketplace. With near zero marginal cost, there is inherent competitive pressure to reduce prices towards zero. This pressure grows as technological change reduces fixed costs and businesses adopt 'free' product business models to compete in this space, such as Google's advertising driven model.

Analysis

A pure cost recovery model where each individual product is priced according to its costs may not be able to generate the revenue required to fully fund the production, maintenance and distribution of spatial data that land information agencies wish to produce. The new models that are being adopted by digital businesses are often mixes of free and paid goods (such as 'freemium' models or time-limited free access) that leverage the exposure and accessibility of the free products to raise revenue from other products. A pure cost recovery approach can create a barrier to being able to effectively compete in the digital marketplace.

Key points

- Alternative pricing models to full cost recovery may need to be considered for land information agencies to effectively compete in the spatial data market.

There were divergent views on whether a return on public investment should be sought

As the production of spatial data is effectively an investment by the taxpayer, some stakeholders considered that there is a case for obtaining a return on that investment. One of Landgate's objectives as spelt out in the *Land Information Agency Act* is to "generate for the State a fair commercial return".[11]

Most stakeholders, however, considered that generation of a return on investment should not be the foremost objective of pricing. It was suggested that the prime objective should be provision of basic information to support effective public decisions and as an enabler of economic development. Assessment of the public goods characteristics and other benefits were also stated to be higher priority considerations.

It was noted that in the case of the Ordnance Survey (prior to April 2010), the requirement for commercial profitability acted as a barrier to consideration of the public good characteristics and positive externalities of the spatial data that it sold. Where a marginal cost pricing approach was more appropriate, Ordnance Survey was not in a position to adopt that approach.

A number of stakeholders both within and outside of government stated that as taxpayers have paid once for collection of the spatial data, they, as the users, should not pay again. The return on the investment is the access to and use of the spatial data itself.

Analysis

In its report *Cost Recovery by Government Agencies,* the Productivity Commission recommended that "Cost recovery arrangements that are not justified on grounds of economic efficiency should not be undertaken solely to raise revenue for Government activities." The is because of the central role that efficiency objectives should play in shaping a pricing regime and the recognition that cost recovery shaped by revenue objectives can create incentives that hamper efficiency. For example, the Productivity Commission noted that an over-emphasis on raising revenue may result in charges for activities for which there should not be cost recovery. ACIL Tasman identified scenarios

[11] Section 8(b)

where over-recovery of costs was taking place through the sale of value added spatial data (ACIL, 2008).

In these circumstances, a return on investment, or cost recovery, should only occur where efficiency considerations or broader welfare based objectives justify it. Consideration of whether taxpayers have already paid for the spatial data is also not directly relevant, as efficiency considerations and welfare objectives should be the primary determinant of who ultimately pays for the spatial data.

Key points

- An objective of a return on investment should be underpinned by considerations of efficiency, public policy, economic development and the public good characteristics of the data.

There is a cost to the acquisition of public funds

Some stakeholders noted that obtaining funding from taxation is not a costless exercise. There are inefficiencies in taxation such as administrative costs and the incentive effect that taxation has on the allocation of resources.

Analysis

The provision of government resources carries with it the inherent inefficiency of taxation. A range of costs are incurred in the collection of tax revenues including collection costs, compliance costs and deadweight loss due to changes in incentives. As a result, the cost of a tax increase and accordingly, the cost to the economy are larger than the amount of revenue raised. This inefficiency is termed the marginal cost of public funds. One recent estimate for Australia is that for $1 of tax revenue, the marginal cost is $1.24, meaning that government funding should only be procured where benefits outweigh costs by a factor of 1.24 (Campbell, 1997).

Key points

- There is an efficiency cost to the acquisition of public funds for the production, maintenance and distribution of spatial data.

The incentives of land information agencies are shaped by the pricing and access regime

A common observation was that the pricing and access regime implemented by a land information agency shaped the incentives it faced.

In the consultations, a number of positive incentives of cost recovery were noted; the primary incentive being to provide what the customers sought. For example, it was suggested that in the case of Landgate, the move to a more commercial basis on its becoming a statutory authority led to some activities that were of no value to any customers being discontinued. It was also suggested that cost recovery increases the incentives for the land information agencies to invest in innovation and research, such as Landgate's investment of 4 per cent of total agency expenditure on research and development.

There was also some suggestion that cost recovery led to users paying more attention to the efficiency of the land information agency, placing some pressure on the agency to be

accountable. An absence of government funding may also generate pressure to reduce costs.

In terms of negative incentives, some suggested that cost recovery policies reduce the incentive for land information agencies to resolve production inefficiencies. This could take the form of either gold plating or cost padding. Gold plating refers to the adoption of unnecessarily high standards, with agencies choosing their own preferred level of service rather than the level required to satisfy client or government objectives. Cost padding is the artificial inflating of costs, which can be done in the knowledge that they can be recovered. Gold plating and cost padding were both recognised by the Productivity Commission (2001) as potential incentives of cost recovery frameworks.

The Productivity Commission also noted that cost recovery could create perverse incentives to not adopt more efficient technologies. If the market for the product is not competitive, the incentive to actively search for cost efficiencies and to innovate new low cost methods is diminished.

Some industry stakeholders thought that a focus on cost recovery, and in particular, on value added products for which it was perceived that there was large revenue potential, was resulting in a failure to give sufficient attention to core activities. This was considered to lead to poorer quality spatial data being delivered for datasets where there was no charge, such as the limited selection of data available for no charge online from some land information agency websites.

Analysis

The incentive effects of cost recovery regimes were discussed in the Productivity Commission's report on *Cost Recovery by Government Agencies* (2001). The Productivity Commission noted that while cost recovery avoids the inefficiencies associated with taxation, cost recovery undertaken merely to raise revenue may be more inefficient than raising the funds through taxation revenue. This is due to the potential for undesirable effects such as gold plating and cost padding.

In the area of spatial data, these incentives might manifest themselves in over-processing of data where more raw data (as opposed to processed data) would be adequate for decision making and private sector uses.

One of the core recommendations of the Productivity Commission to address negative incentives was the avoidance of cost recovery targets. It was recommended that the practice of requiring recovery of a certain proportion of agency costs be discontinued.

The Productivity Commission also recommended that the adoption of output pricing reviews would bring some discipline to the application of cost recovery, provided it was done in an appropriately transparent manner.

Key points

- The incentives created by the pricing and access regime must be compatible with the objectives of that regime.
- An output pricing review provides a method of monitoring the effect of negative incentives.
- Targets to cost recover a specific proportion of agency costs should not be adopted.

7.2 Efficiency

Efficient level of consumption

A number of users of spatial data, both within and outside of government noted the inefficiency inherent in having a product available that can be distributed at near zero marginal cost but for which they could not gain access at that price. In the case of private sector users, it was at times noted that the price should be set to equal marginal cost. Government users are more focused on the practical consequences of not having information for decision making where that information is already available within government.

Analysis

The efficient level of consumption of a good occurs where price equals marginal cost. If the output is priced above marginal cost, there will be consumers who value the good for more than marginal cost who do not purchase the good. This results in what is known as a deadweight loss, which is the value that would be gained by consumers if they could purchase at a price equal to marginal cost. A price below marginal cost also results in a deadweight loss, which in that case is the gap between the marginal cost incurred by the producer and the value placed on the good by purchasers who value the good for less than marginal cost.

Where production of a product has natural monopoly characteristics, as was noted in section 3.1 is the case for most fundamental spatial data products, the marginal cost is generally well below the average cost of production. Pricing at marginal cost cannot result in full recovery of the cost of production, which results in a loss to the producer. However, the gain to consumers from marginal cost pricing (as opposed to say, average cost pricing) is generally greater than the loss suffered by the producer, resulting in a net societal gain.

Similarly, an attempt to maximise the revenue from the sale of spatial data will result in the net welfare from the sale of the information being less than for a marginal pricing regime. Where a monopoly exercises its market power and seeks to maximise revenue, it does so by restricting supply and raising the price. The high prices and low levels of consumption result in a larger deadweight loss than that for cost recovery pricing as there is an even larger number of consumers who cannot obtain the product but who are willing to pay at or above the marginal cost of production.

Key points

- The efficient level of consumption of a good or service occurs where price equals marginal cost.
- Pricing a good or service at average cost (where average cost is higher than marginal cost) or to maximise revenue will result in under-consumption of the good or service.

Spatial data creates value beyond the initial purchase

Flowing from the recognition that spatial infrastructure plays an important role as ‘soft infrastructure’, there was also broad agreement that there are multiplier effects through the use of spatial data. It was suggested that multiplier effects may be increasing with

technological change as the uses of spatial data increase and the ability to transmit information products continue to undergo fundamental change through the development of internet based technologies.

It was noted that there is an inherent unpredictability as to the shape and size of any multiplier effects that would arise under a more liberal pricing and access regime. It was considered that the type of innovation likely to occur is inherently unforeseeable, although there is strong evidence of previous innovation creating value in this area, such as that associated with Google Maps.

There are no specific estimates of the size of the multiplier in the literature on spatial data. Newberry et al (2008) examined multiplier effects in a range between 1 and 10, although all analysis in that paper was checked against the lower bound of 1 to ensure that multiplier effects were not driving the analysis in that particular case.[12]

Analysis

Spatial data typically forms part of a value chain of uses. Consideration of only the first use of the spatial data by the immediate purchaser tends to ignore the surpluses that are generated further down the value chain. The non-rivalrous nature of spatial data increases its capacity to continue to add value at all stages of the value chain process. As a result, when calculating the gains or losses from specific pricing arrangements, the application of a multiplier to the value placed on the information by the initial purchaser is usually appropriate.

Positive externalities (spillovers) are maximised when the datasets are available at marginal cost (effectively free over the internet) to all users. Marginal pricing would allow greater access to and increased dissemination of the datasets. This would promote greater levels of innovation and commercial applications that may result in technological advancement and increase in productivity. The Inquiry by the Victorian Parliament's Economic Development and Infrastructure Committee (2009) supported the argument that the potential for society to benefit provides a justification for society to bear the cost through government funding.

Use of a multiplier is also appropriate due to the public good characteristics of spatial data. Significant positive externalities may be generated by the use of spatial data, including in public policy decision making.

Key points

- The multiplier effects from the use of spatial data should be considered in determining the appropriate pricing and access arrangements for the spatial information product.
- Multiplier effects are at their largest when dissemination of the spatial data is maximised.

[12] Consideration of the size of the multiplier will form part of Stage 2 of this project.

Land information agencies need signals as to what data should be produced

A basic decision facing many land information agencies is the question of what spatial data products should be produced. To determine this, it was recognised throughout the consultations that there is a need for some type of signal from the users of the spatial data as to what those products should be. Pricing was considered to be a reliable signal.

The two way nature of pricing signals was also noted by many stakeholders. Cost recovery pricing provides an indication to the purchaser of the cost of producing, maintaining and distributing the spatial data. By being exposed to these costs, businesses are then more realistic in the demands and expectations they place on government and only make demands to the extent there is value in the product commensurate with the cost of production. There was also a perspective among both industry and land information agency stakeholders that data are more valued if there is a payment made.

One stakeholder suggested that while pricing signals are important, they are only useful to the extent that they are being used to achieve clearly articulated objectives. They considered that the objectives of most land information agencies were not in such a state. It was also noted that while there was potential for the use of pricing as a signal, it was not practically being used as such, particularly for the production of fundamental spatial data. This was considered to be because fundamental spatial data was either a by-product of regulatory processes or considered a core function of the agency and would be produced regardless of evidence of a willingness to pay.

The ABS noted that there was a range of alternative means of obtaining customer feedback. For example, the Australian Bureau of Statistics (ABS) draws on user and advisory groups, meetings with representatives of government agencies that use ABS statistics for policy purposes, forums involving non-government and/or government delegates and consultations to seek to ensure that ABS statistics meet user requirements.

It was also noted by some participants that the further integration of Web 2.0 mechanisms into the development and distribution of spatial data may increase the ability to harness interaction with data users.

Analysis

Prices signal to consumers the cost of servicing them, and the volume consumed at that price signals to the supplier the strength of demand and marginal value for each product or service. Pricing provides a signal that resources should be allocated to production. It was for this reason that cost reflective pricing was at the heart of many microeconomic reforms in the 1990s.

In the absence of pricing, particularly where access is freely available online, it is difficult to determine who is accessing the data, how the data are being used and what value the data is creating. While the absence of downloads indicate a lack of interest in that data set, the presence of high download volume may not be evidence of value being created further down the value chain that justifies the initial investment.

Knowledge of the customer base provides further benefits in that customer feedback can be sought in relation to the products being supplied and whether improvements or changes to these products would create more value. The presence of a price ensures that this feedback is not just “cheap talk”.

In the case of a non-rivalrous good such as information, pricing is not always a reliable signal. Where there are multiplier effects and broad benefit to society through the free release of the information, it may be socially optimal to provide government resources for production even where the pricing signals are not present to a level that would normally indicate production is required. In such cases, alternative methods of determining the value of the information such as surveys or an analysis of the value chain may be required.

A further issue is to what extent pricing signals are used to shape the collection, production and distribution of information. Where a land information agency is required to produce the information for public policy or some other purposes, regardless of the external demand for the product, pricing no longer has a role to fill. Pricing at the full cost, including collection costs, would be an inaccurate signal of whether to invest in distributing the product if the only cost faced by the agency is the cost of distribution.

Key points

- The value of pricing as a mechanism for achieving efficiency is contingent on production decisions being based on the pricing signals.
- Where there are multiplier effects and broad benefit to society, it may be socially optimal to provide government resources for production even where the pricing signals are not present to a level that would normally indicate production is required.
- In these circumstances, alternative methods of obtaining signals as to value are available.

Multiple players in the value chain for spatial data can result in the duplication of fixed costs

Some land information agencies stated that one of their roles was preventing the duplication of value adding services and assembly of fundamental data from raw data that could be more efficiently provided by a single party. One agency stated that evidence of duplication would suggest that the agency was not fully performing its role. Another agency stated that identification of an area of duplication would provide prima facie evidence that they should enter into that area. Conversely, one land information agency considered that prevention of duplication should only be in the area of fundamental data, whereas competition for value added products should be encouraged.

An industry perspective regarding duplication was that it was often only an impression of duplication as products are carefully tailored to end user needs. The fitness for purpose of each product was much higher for each specific customer that the numerous value adding parties serviced. Private sector providers understand the end users better and advancement of their data applications have exceeded that of government.

It was also noted that the cost efficiencies that can be generated through competition may ultimately outweigh the short term inefficiency that occurs through the duplication of services in the short term. Competition requires the least cost methods of production to be adopted (productive efficiency) and creates an incentive for innovating lower cost methods of production.

Analysis

Allocative efficiency considerations suggest that for a natural monopoly (or a non-rivalrous good such as information), a single producer is the most efficient outcome. If only one producer incurs the fixed costs associated with production, production costs are minimised. However, dynamic efficiency considerations suggest that the innovation and cost efficiency driven by competition among multiple producers may deliver longer term efficiency.

The balance between these considerations has implications for what data government makes available, at what price it is made available and what parts of the value chain government engages in. For example, the processing of raw or fundamental data into more user friendly product by government before sale will minimise duplication of this service. However, there will then be no competition in the provision of these services, potentially leading to inefficiencies and a lack of innovation in the data processing.

A further dynamic consideration is that competition in an industry with natural monopoly characteristics may lead to a single dominant player which will then have monopoly pricing power and would be expected to restrict production to exercise this power. In those cases, there may be advantages to having government as that monopoly provider. Alternatively, if monopoly powers were transferred to the private sector, some form of price regulation may be optimal.

Issues concerning duplication and natural monopoly characteristics are not static, with reductions in fixed costs in the collection of spatial data leading to intense competition and innovation in some areas, despite the historic natural monopoly characteristics of this activity. Any assessment of the costs and benefits of duplication of value adding and processing services must take into account technological change.

Key points

- Allocative efficiency for a natural monopoly occurs where a single player is active in the market.
- Apparent duplication of services in the processing of spatial data may be leading to highly customised, discrete products for consumers.
- The natural monopoly characteristics of elements of the spatial data industry are changing rapidly with technological change.

The distribution of spatial data involves administration costs

Some participants in the consultations noted that the administration costs involved with a cost recovery based pricing and access regime may be significant. It was suggested that in some cases administrative costs may exceed the revenue raised through the sale of spatial data products. Such costs include:

- price reviews and oversight
- licence development
- compliance and enforcement
- administration of differential pricing.

It was also noted, however, that there may be other administrative costs involved with administering a marginal cost (free online) pricing framework. Possible sources of increased administrative costs included increased customer demands (through a higher number of customers and no demand control) and managing groups or surveys to determine what products will be produced.

Analysis

The pricing, licensing and distribution of spatial data carry inherent costs. These costs are borne by both public and private sector participants in the spatial data industry.

The public sector bears the costs involved with developing and implementing pricing policies and models, the drafting and negotiation of licence conditions and administration costs at the point of sale such as invoicing and customer service. The scale of these costs are dependent on, among other things, the level of complexity in the pricing and access model, the degree of negotiation and tailoring of solutions with customers and the volume of customers.

While there may be some capacity to pass these public sector costs on to the data purchaser, these costs represent a deadweight loss to society generally. Furthermore, where these costs cannot be passed on, they may reduce the net revenue that is obtained through the sale of spatial data.

The private sector also incurs administrative costs relating to the pricing and access regime. These include costs relating to payments, negotiation of prices and licensing. Depending on the complexity of the licence and the standard agency arrangements, investment must be made in negotiation of licence terms and interpretation of the licence conditions. Where the spatial data package consists of data from multiple licence holders, there may be costs involved in locating and negotiating with a large number of parties. Failure to locate a licence holder may lead to a hard barrier to access. As for public sector administrative costs, private sector administrative costs represent a further deadweight loss.

Operating under a pricing and access regime with distribution at marginal cost (free online) and a liberal licensing framework such as Creative Commons Attribution, while avoiding many of the costs noted above, carries with it its own administrative costs. For example, the consultative groups run by the ABS will have costs. There may also be costs associated with the policy decisions as to which datasets should be made available at marginal cost.

The scale of the administrative costs in each case must be included in the cost benefit analysis as to the production of the spatial data and the optimal pricing and access framework.

Key points

- Administrative costs are incurred through the pricing, access and distribution of spatial data.
- Where the administrative costs of the pricing and access regime exceed the revenue obtained, consideration should be given to moving to a low administrative cost model such as free online distribution.
- The administrative costs should be incorporated in any cost-benefit analysis to determine the appropriate pricing and access regime for a spatial data product.

7.3 Adaptation and change

Competition induces efficiency and innovation

A number of parties noted that where basic fundamental spatial data has been provided at zero or marginal cost, increased use of the data by value added resellers has resulted in more products and lower prices due to increased competition and innovation. Attempts by land information agencies to create more highly processed, fit-for-purpose products and cost recovery pricing was suggested to reduce the degree of fit for some customers and the range of products available to them.

Some industry stakeholders also suggested that the lack of competition at various stages of the value chain have resulted in land information agencies operating at less than full productive efficiency.

The majority of industry survey respondents considered that there is not a level playing field between the private and public sectors with respect to the supply of fundamental spatial data to the market or in the production of value added services. Reasons given for this included price discrimination between private and public sector purchasers and a failure to incorporate the full costs into products, allowing the public sector agency to outcompete on price.

Analysis

Competition induces efficiency and innovation. Participants in a competitive market must adopt the lowest cost technologies in order to offer prices that are competitive in the market. These competitors also have the incentive to develop new low cost methods of production, with innovation over time reducing costs and prices across the industry.

As the production of fundamental spatial data exhibits natural monopoly characteristics, there are barriers to competition and in fact, potential efficiencies from a single participant undertaking production. If multiple competitors are in a natural monopoly market, they duplicate the fixed costs where a single competitor would only incur these once. The duplicated fixed costs are effectively a deadweight loss. However, the efficiency gained through a single participant incurring the fixed costs may be outweighed by the cost efficiencies that may be driven by competition and the innovation of new low cost production methods.

Competition can be enhanced by the availability of intermediate products. Where there is full cost recovery of spatial data, availability of the raw data sets in addition to the processed “fit-for-purpose” products will allow competition in the data processing sector even where the natural monopoly characteristics of information collection prevent effective competition through the whole value chain.

Competition may result in products that are more fit-for-purpose for specific customers. Deloitte (2010) suggested that the pre-packaging of government information, which agencies tend to do, limits its usefulness. Access to raw data, in combination with other data sources, can result in information products that governments do not provide.

Competition in the spatial data market may also be hampered by the distribution of spatial data at marginal cost or at the cost of extraction and distribution. No market participant can compete with a government distributing spatial data at zero cost. While multiplier effects may provide a policy reason for marginal cost distribution, the cost efficiencies and innovation from competition will not be realised.

Evidence from the United States suggests that a highly competitive private sector in the production of both fundamental and value added data has emerged under a free data policy, although the free, publicly provided fundamental data are generally outdated.

Key points

- Competition in the processing of spatial data can increase the range and decrease the prices of spatial data products.
- Marginal cost (free online) pricing can harm competition through undercutting private sector participants in that part of the value chain.
- Competitive neutrality principles should be implemented unless there are sound policy reasons for pricing and granting access to spatial data in a manner inconsistent with these principles.

The demand for and supply of spatial data is changing rapidly with technological change

Many stakeholders noted that technological development is reducing the cost of obtaining spatial data. Drivers of this change included global navigation satellite system technologies, satellite imagery, improved information technology and in recent times, Web 2.0 mechanisms such as user generated data.

However, technological change has also been resulting in some cost increases. Technology is enabling the capturing of higher quality data, such as increased imagery resolution. This requires larger storage capacity and where delivered through online means, increased delivery capacity. Stocks of imagery held on film are being digitised, such as the NSW aerial photography archives, increasing storage requirements. The broadening of technological applications and uses of spatial data is also resulting in users demanding accessible, higher quality spatial data, which carries cost implications.

Analysis

Technological change is having significant effects on the demand for and supply of spatial data.

The basic technologies for the collection, maintenance and distribution of spatial data have undergone significant change over the last 20 years and continue to rapidly evolve. For example, satellite imagery is availability is growing, with an increasing number of providers providing higher resolution products. User generated data are providing the private sector with a new low cost avenue of generating spatial data.

The internet has eliminated many of the barriers to participation in the spatial data industry. The continued development of internet based applications has increased the ability of users to access spatial data and the range of applications for which spatial information can be used. There is increased innovation and entrepreneurialism with spatial data. Consumers of spatial data are demanding accurate and detailed data with a user friendly interface. The broad usage of Google Maps and Google Earth is an indication of the growing use of spatial data.

Increased demand for spatial data is a driver of increasing supply costs. Demand is increasing for both the available spatial data and the quality of that data. User expectations are changing. The demand for higher resolution results in larger storage

capacity requirements. Higher usage requires greater bandwidth. These all result in associated expense.

Technological change also has implications for licensing. Development in technologies that have driven the marginal cost of distribution towards zero has increased the potential for broad distribution and potential multiplier effects. A licensing regime that facilitates online distribution will enhance multiplier effects. The Government Information Licensing Framework (GILF) project in Queensland is in part a response to this technological change.

Key points

- Technological change is having significant effects on the costs of supplying spatial data and the demand for information.

The role of government in the supply of spatial data is changing with technological change

It was widely noted through the consultations that the role of government in the supply of spatial data was not static and was influenced by technological change. However, there was divergence in views as to what the implications of this might be.

Land information agencies generally considered that technological change is leading to demand for more refined products from government and that government should engage in more processing and produce more fit for purpose products. This might be seen as expanding the scope of what is considered to be fundamental data. It was stated that multiplier effects could be enhanced if data was more fit-for-purpose. The involvement of Landgate in producing some value added products might be seen to reflect this view. Some agencies also considered that the private sector was risk averse and that investment in research and new products by the public sector was required to continue to spur innovation and technological advance.

As a counterpoint, some others saw a shrinking role for government. As an example, one participant suggested that the costs of aerial photography had progressed to an extent that there was active competition in the aerial photography market and that there was no longer any need for government to play this role.

There was also a suggestion that government is a ‘generation behind’ the users of spatial data and those users are becoming more technically savvy with raw data. As a result, consumers from outside of the major users of spatial data do not require the level of processing that government feels obliged to provide.

Analysis

While technological change is likely to change the role of government in the supply of spatial data, the implications are likely to vary across data sets. For example, the cadastre is likely to remain within the realm of government for the foreseeable future.

The changes in cost are likely to change the competitive landscape in the development and supply of spatial data. While the collection and distribution of spatial data has natural monopoly characteristics, the potential for new competitors to enter increases as fixed costs decrease. For example, improvements in satellite and aerial imagery technology will lead to a growing number of competitors in these segments. Competitors will also be integrated across the value chain and active across global, national and local

geographies. This will create downward pressure on prices. For example, Intermap Technologies, headquartered in Colorado, developed an elevation model of the entire United Kingdom in four months, allowing it to directly compete with Ordnance Survey and deliver substantial price reductions to customers. It has since sold data to governments and private sector players throughout the United Kingdom (Intermap Technologies 2002, 2004).

In these rapidly changing circumstances, there is a need for pricing and access system that is flexible enough to deal with the change. There needs to be flexibility by government to change its role where appropriate, and for the pricing and access regime to be able to facilitate that change.

Key points

- The government's role in the spatial data industry should be adjusted where justified due to technological change.
- The pricing and access regime for spatial data should be flexible enough to be able to reflect changes in the government's role and the effect of technological change.

7.4 Access

There were divergent views as to how access and distribution of data should be controlled through licensing

It was commonly agreed through the consultations that poor quality spatial data has the potential to cause losses to parties that use it. Some land information agencies noted the potential for loss created potential legal ramifications if the distribution of spatial data was not carefully controlled. Some land information agencies have concerns as to the legal implications of a liberal access and licensing model. These include legal liability from the circulation of out-of-date data and inappropriate uses or misinterpretation of that data. Under a liberal license, such as the Creative Commons Attribution licence, the data producer effectively loses control over which parties use the data and in what manner it is used, with it unlikely that the identity of the users will be known. A strict pricing and licensing regime enables the data producer to exercise control.

One participant noted that a review during the Queensland GILF process could not find any instances of legal action in Australia arising from the distribution of spatial data (OSDM, 2008). Some parties also suggested that while there may be legitimate concerns about control, the requirements for attribution and legal liability waiver contained in a Creative Commons type licence, and the ability to use metadata to place warnings and describe the information can provide adequate protection.

A number of stakeholders noted the broad adoption of Creative Commons licences at the Commonwealth level and the benefits that those agencies have gained. As an example, the Bureau of Meteorology is required under the *Water Act 2007* (Cth) to engage with around 240 organisations that provide water information to the Bureau. These organisations are mainly state and local government organisations. The Bureau of Meteorology has obtained agreement from 95 per cent of these organisations to provide the data under a Create Commons Attribution licence. This allows the Bureau to use the data obtained under a Creative Commons licence as required and freely make available

to other users, reducing administrative burdens and increasing the accessibility of the data.

The majority of industry survey participants stated that licensing restrictions (along with bureaucratic processes) were the main problem that was experienced in obtaining fundamental spatial data.

Analysis

While there is little evidence of legal action around misuse of government information in Australia (OSDM, 2008), maintaining adequate legal protection remains a prudent measure. The central issue is which licensing regime provides the best protection.

It may be argued that a standard licensing model such as Creative Commons provides stronger protection than bespoke licences that are developed on an agency by agency or dataset by dataset basis. The heavy level of scrutiny and use of the Creative Commons licences provide a robustness that a licence tailored by an agency official may not have. Restrictive copyright provides no more protection against the continued use of out-of-date information than a Creative Commons licence, and in fact, pricing may act as a barrier to obtaining the most up-to-date set. If a user of a dataset that has been through a number of value adding processes or transfers wishes to check or obtain the original source, the absence of a charge for access will allows this.

Further, alternative protective measures such as the use of metadata that delineates data quality and currency may provide protection from inappropriate use.

Key points

- PwC is not aware of any evidence that a liberal licence such as a Creative Commons licence poses a greater legal risk than traditional restrictive licensing.
- Measures such as the use of metadata that delineates data quality and currency may provide protection from inappropriate use.

Non-commercial uses of spatial data can create value

Non-commercial users of spatial data were not consulted during the consultations. The land information agencies consulted indicated that access for non-government, non-commercial users at discounted prices, even where expressed in legislation, was not a core area of focus. This was evidenced in the lack of any indication on agency websites or materials that discounted pricing is available and the lack of any transparent processes or information as to how applications by non-commercial, non-government customers for fundamental data are assessed.

Analysis

Non-commercial users of spatial data may create community benefit. This may be through the use of spatial data in public policy decision making, the enabling of improved participation by citizens in public policy and other non-commercial uses such as by charities.

Non-commercial users are not able to access the information under some pricing policies. Pricing of public sector information creates a barrier to participation in

government. Non-commercial users may not be able to capture value commensurate with the price they pay and accordingly, pricing prevents access.

Barriers to access for non-commercial use can also arise through non-pricing constraints. For example, many land information agencies have scope for discounting from full cost recovery to marginal cost or free for certain non-commercial users. However, this may require application and satisfaction of a number of criteria such as community benefit. Showing satisfaction of these criteria may be administratively difficult and access may be prevented where there are issues such as concerns that the data will be misrepresented, misused or used to embarrass the government.

As for commercial uses, the provision of spatial data to the non-commercial sector at a price above marginal cost will result in a sub-optimal level of use of the spatial data. The positive externalities associated with the non-commercial uses may also justify discounting to zero.

Where price discrimination on the basis of non-commercial use is applied, this presents a number of administrative issues. Firstly, identification of non-commercial use is not always transparent, particularly where an organisation possesses commercial and non-commercial elements. Secondly, discounting on a case-by-case basis creates an administrative burden. Assessment of criteria such as public benefit (which is part of the test applied by Landgate) implies a further administrative burden on the agency.

Key points

- Pricing fundamental spatial data above marginal cost for non-commercial use results in a sub-optimal level of use of the information.
- The positive externalities generated through non-commercial uses may also justify discounting from full cost recovery.

7.5 Governance and implementation

Compliance with legislation

A number of land information agencies recognised the presence of broader constraints to their pricing and access policies than their own objectives. This included the establishment of pricing guidelines in legislation, plus legislation that through indirect application effectively require the adoption of certain strategies. In all jurisdictions, land information agencies were subject to competitive neutrality policies.

Analysis

Any pricing and access framework must be able to operate within the legislative environment under which it is established. In some cases, legislation may constrain the ability of an agency to select certain pricing and access policies.

Where the legislation is agency specific and does not reflect the optimal pricing and access model, consideration should be given to amendment. Consideration should also be given to whether the legislative framework provides the flexibility required to operate in a rapidly changing technological landscape.

Key points

- Consideration should be given to establishment of a legislative framework that provides for both the optimal pricing and access policy and the flexibility to adapt with technological change.

Transparency

Some industry stakeholders expressed a lack of clarity concerning the pricing and access regime that they operate within. They considered that this was due to a lack of transparency. Without knowledge of the pricing framework, they felt unable to assess the appropriateness of the price they faced.

Analysis

Transparency in pricing and access is an important element of accountability. It facilitates prices oversight by industry and allows pressure to be brought to bear where it is considered that pricing policy is inappropriate or being inappropriately applied.

Transparency is also important in delivering business certainty. A transparent pricing regime provides information as to what prices will be faced, allowing investment decisions to be made with confidence.

The Commonwealth, Western Australian and Victorian pricing policies are publicly available. In the Commonwealth's case, the Commonwealth's policy document is available online. As the Commonwealth provides fundamental spatial data at the marginal cost of transfer, there are no further public documents detailing pricing methodology.

The pricing and access policies for Victoria are detailed in a number of documents that are freely available online, including the *Victorian Spatial Information Strategy* 2008-2010 (Victorian Spatial Council, 2008), the *Spatial Information Access Guidelines* (Victorian Spatial Council, 2009a), the *Spatial Information Pricing and Licensing Guidelines (Second Edition)* (Victorian Spatial Council, 2010), the *Spatial Information Pricing Methodology* (Victorian Spatial Council, 2006) and the *Cost Recovery Guidelines* (Department of Treasury and Finance, 2007). These set out, among other things, the basic policy and methodologies for calculation of prices for cost recovery.

In Western Australia, the Cabinet endorsed *WALIS pricing and transfer policy* is available online. Landgate's pricing and access policy is publicly available to the extent that it is spelt out in the legislation or regulation. This includes the list of fundamental data sets that may be available for non-commercial use at the cost of extraction and provision. Policy documents on how the pricing policy is to apply in practice are not in the public domain.

In the case of both Western Australia and Victoria, the criteria to obtain a discounted rate for non-commercial use are also not publicly available.

Key points

- Pricing and access policies should be transparent to provide certainty and facilitate accountability in pricing.

Governance must be adequate to support implementation

Some stakeholders considered that even where a suitable pricing and access regime was in place, there were instances where the operation of the regime was sub-optimal. This was largely considered to be a function of the incentives facing the agencies under a cost recovery framework. These included cost padding and gold plating and insignificant attention to core datasets that were offered at marginal price or for free.

Stakeholders considered cost padding to occurring through excessive staffing levels, although it was also noted that Landgate had improved in this regard since its establishment as a commercially orientated statutory authority. In relation to gold-plating, the unavailability of raw data or unprocessed data was suggested to be a problem, with the value adding undertaken by the agencies resulting in additional cost greater than the value gained by the customer.

Analysis

As should apply to any government agency, and in particular an agency with natural monopoly power, appropriate governance mechanisms should be in place

Governance mechanisms might include:

- transparent reporting of cost recovery arrangements as part of the budget process
- publicly available pricing frameworks and policies
- prices review / oversight
- mechanisms to promote meaningful consultation with stakeholders
- introduction of competitive pressures.

Key points

- Governance mechanisms must be adequate to support the implementation of the pricing and access framework that is chosen by government.

There are inter-jurisdictional inconsistencies in pricing of and access to spatial data

Some industry stakeholders noted the inconsistencies in pricing and access policies across jurisdictions and the costs that come with this. However, this was considered to be a light burden and of lower concern.

A number of state land information agencies noted that there was a basis for a difference in policy between the Commonwealth and State Governments. Firstly, this was due to both the roles of the Commonwealth and State levels in the provision of spatial data, with the States generally have a higher level of investment in spatial data collection and management infrastructure.

Secondly, some government stakeholders considered that the broader taxation base of the Commonwealth placed the Commonwealth in a better position to provide funding for spatial infrastructure through taxation revenue.

Analysis

The pricing and access regimes adopted across Australia, its States and Territories and New Zealand are generally inconsistent. Inconsistency is also present in the standards and formats that are adopted.

Inconsistency in pricing and access policies carries an inherent inefficiency. Where a data purchaser is acquiring data from different jurisdictions, it requires the adoption of different processes. The inconsistent pricing and access may also result in the allocation of resources by users that is distorted by the different policies.

As the pricing and access to fundamental spatial data should be assessed on a dataset by dataset basis (see section 6.2.6), there may be some inconsistency at an overall level. Differing objectives may also result in some inconsistency. However, where similar data sets are being produced in different States, inconsistency should be minimised in order to avoid misallocation of resources and to reduce the administrative burden of multi-jurisdiction organisations having to deal with multiple pricing and access regimes.

Key points

- Pricing and access to fundamental spatial data should be applied consistently across jurisdictions.

8 Assessment of existing pricing and access policies

This chapter contains an analysis of the pricing and access regimes for the Commonwealth, Victoria and Landgate in Western Australia against the principles and objectives identified in chapter 6.

8.1 Hard constraints to access

The pricing and access policies in all three jurisdictions generally have no explicitly stated non-price constraints to access to spatial fundamental data. The only area where there might be considered to be a hard constraint is in relation to spatial data of a less processed (raw) form, such as unprocessed topographic data. Here, the constraints relate to privacy issues and the desire of land information agencies to maintain a degree of control over raw information to ensure correct interpretation of the data. These constraints, while understandable, raise the question of whether the processing of raw data possesses natural monopoly characteristics, resulting in a single processer being more efficient, and to what extent dynamic efficiency might be generated by competition in this area.

There are also other non-price barriers that may act as constraints in practice. In both Victoria and Western Australia, discounting for non-commercial use requires an application and satisfaction of criteria as assessed by the land information agency. Processes for obtaining such access are not advertised or indicated on the respective agency's websites, there is no transparent process to follow and it may be difficult to satisfy the criteria. This may act as a barrier to access.

8.2 Efficiency

Efficiency features as part of all three jurisdictions' policies, whether as an explicit objective or implicitly through adoption of Treasury pricing guidelines. However, the link between these efficiency objectives and the adopted policy is generally not spelt out.

The efficiency referred to in the Commonwealth's Spatial Data Access and Pricing Policy is allocative efficiency, but from the perspective of the level of consumption of the spatial data. Consumption levels are efficient where price equals marginal cost, which in the case of online information, is close to zero. The increases in use in Geoscience Australia data on the shift to free access policy demonstrate the level of unsatisfied consumer demand at previous prices above marginal cost. Between 2002-03, the first full year of operation of the Commonwealth policy, and 2005-06, the number of downloads of datasets covered by the policy increased from 50,000 to 1.6 million (OSDM 2009).

The Victorian *Cost Recovery Guidelines* (Department of Treasury and Finance, 2007) and *Spatial Information Pricing and Licensing Guidelines* (Victorian Spatial Council, 2010) refer to efficiency as one objective of pricing. This is stated to be for allocative efficiency as "[f]ull cost recovery ensures that all the relevant costs of bringing the good/service to market are incorporated in the relevant price signals."

In the Western Australian case, the Treasury guidelines have cost recovery as the default pricing policy due to allocative efficiency; the need to ensure that "resources are not allocated inefficiently". Cost recovery or commercial pricing can result in allocative

efficiency by ensuring that resources are not allocated to production of goods and services that are not valued. Dynamic efficiency may also be affected as the pricing signals are used to shape production over time. However, cost recovery can prevent access at a price equal to marginal cost, which results in under consumption of the good. This is particularly so in the case of low marginal cost data products such as spatial data. The non-rivalry of information can also lead to further under consumption where full cost recovery is applied.

The *Land Information Authority Act* provides for pricing within government at the cost of extraction and provision. This potentially provides for efficient levels of consumption. However, it prevents the operation of a pricing signal within government. For non-commercial non-government uses, pricing may be at the cost of extracting and provision where the non-commercial entity has functions of a public nature and it is for research, education or activities of a community or regional nature.

In both Western Australia and Victoria, there is an administrative cost to the setting of prices and developing licenses under the cost recovery regime. Administrative costs represent a deadweight loss and negatively affect efficiency. Geoscience Australia does not incur pricing or licensing costs under the Commonwealth's Spatial Data Access and Pricing Policy. However, Geoscience Australia does not have the benefit of the pricing signals that come from the prices. During consultations, one industry stakeholder noted that Geoscience Australia's focus was at times on products with little commercial value, with no pricing signal available to deliver that message.

In that respect, the cost recovery pricing policies of the Western Australian and Victorian land information agencies provide a degree of accountability to these organisations. In the Western Australian case, the pricing at the cost of extraction and provision within government weakens the potential for internally controlling demand for spatial data. The absence of pricing for Commonwealth government data prevents pricing from playing this accountability role.

8.3 Public goods and positive externalities

The treatment of public good and externality issues in the pricing and access of spatial data is closely linked to efficiency. Where there are public good characteristics and positive externalities, pricing above marginal cost can result in under consumption and a social loss. Even marginal cost pricing may be too high in these circumstances if an individual is unwilling to pay the marginal cost but the externalities or gains from the public good outweigh the marginal cost.

There is provision in the Victorian Spatial Council policy for considering public good and positive externality factors. Adopted from the *Cost Recovery Guidelines*, the explicit discretion to not apply cost recovery pricing where there are public good characteristics or positive externalities creates the ability to mitigate under-consumption issues.

For Western Australia, there is consideration of public good characteristics and positive externalities at the Treasury level. However, due to the pricing regime for fundamental spatial data being contained in the *Land Information Authority Act*, the discretion of Landgate to change pricing due to public good characteristics or positive externalities is much more limited, and in the case of commercial uses, only available in exceptional cases. Provisions that enable the supply of fundamental spatial data by Landgate within government at the cost of extraction and provision facilitate the positive externalities that can come from the availability of data for public policy decision making. Similarly,

availability to some non-government non-commercial uses also allows for realisation of some public good and positive externality benefits.

For both Victoria and Landgate, the practical application of policies to facilitate access at prices less than cost recovery appear to be limited outside of the government sphere. As noted above, in Victoria and Western Australia, the process for obtaining discounted pricing such as marginal cost pricing for non-commercial uses may create a barrier to access, even where there is a real chance of obtaining discounted pricing.

Landgate does not advertise or provide an indication of the availability of discounts for non-commercial use, with this possibility only publicly available through it being contained in legislation. Where a non-government organisation becomes aware of such a possibility, they are required to write a letter to Landgate requesting the particular spatial data. Any approval granted is one-off and further approval must be granted if any further datasets are requested by that organisation.

The Victorian process for discounting for non-commercial access to spatial data is based on case-by-case negotiations, rather than being formally documented. Users need to meet a series of criteria to gain access, which can be difficult to satisfy. In its submission to the Victorian Inquiry into Improving Access to Victorian Public Sector Information and Data, the CSIRO (2008) noted that while Victorian spatial data are provided to other government departments, pricing reduces its availability to the research community. The CSIRO stated that open access to spatial data by the research community could have both economic and social benefits.

The Commonwealth policy, by default, does not result in any public good or positive externality issues.

8.4 Equity

Equity is an explicit goal of the spatial data pricing policy under Victoria's *Cost Recovery Guidelines* and the *Spatial Information Pricing and Licensing Guidelines*. They state that horizontal equity is achieved when those who benefit pay the associated costs. Cost recovery avoids all taxpayers having to pay regardless of the benefit. Vertical equity is also noted in that government may choose to apply different fees in order to maximise the access of certain groups. Equity is also noted in Western Australia's Treasury policy to be a result of cost recovery policies.

In Victoria and for Landgate, the cost of the spatial data is not fully recovered through pricing and sales, resulting in the initial users not paying the full costs. Whether this might be considered to be a horizontally equitable position depends upon the balance of benefits accruing to the purchasers and taxpayers. These benefits are likely to depend upon the public good characteristics and positive spillovers of the data. In relation to vertical equity, the provision for discounted access in both jurisdictions may address vertical equity, although the barriers to discounted access noted above may limit the effectiveness of these measures.

In the case of the Commonwealth, the initial user does not pay for the spatial data. If the initial user obtains any value from this data, the benefits they receive will be above the level of their contribution to the costs of the spatial data. However, if the Commonwealth data were considered to be a public good with broad community benefit, as the Commonwealth policy assumes, this may be an equitable result with the taxpayer being both payer and beneficiary.

8.5 Competition policy

The way in which the pricing and access regime in each jurisdiction deals with competition policy implications varies.

In Western Australia and Victoria, commercial provision of fundamental spatial data is subject to competitive neutrality considerations. Landgate considers that the procedures for full cost recovery pricing plus a commercial return result in competitive neutrality requirements being met. For Victoria, there is provision to charge above full cost recovery where competitive neutrality requires. Discounting for non-commercial use in each state has potential competitive neutrality implications, although the policy reasons for the discounting may be suitable to waive competitive neutrality requirements.

For the Commonwealth, competitive neutrality is not sought to be achieved with fundamental spatial data available online for no charge.

In these three jurisdictions, there are few competitors in the production of most of the fundamental spatial data. However, this is changing as the natural monopoly characteristics of the industry change. For example, there are now private providers of aerial photography in most jurisdictions.

There are some restrictions on competition in the processing of spatial data in Victoria and Western Australia. While the processing of raw data to produce fundamental spatial data may exhibit natural monopoly characteristics, the lack of access to raw data by potential competitors may result in lower productive and dynamic efficiency.

Prices oversight in Western Australia and Victoria is limited. For example, Landgate's prices for fundamental data products are reviewed by the Minister and Treasury as part of the annual budget process. However, there is no formal, independent process of review, no opportunity for submission by interested parties and no publishing of recommendations or reasons behind pricing decisions.

8.6 Pricing and access by product, not agency

The Commonwealth and Landgate differentiate pricing by product to the extent that there is a division between fundamental and non-fundamental data. However, within those products considered to be fundamental, the policy is applied uniformly across all datasets. In the case of the Commonwealth, it might be argued that all data was assessed as falling within the basic information set defined in the Commonwealth's *Cost Recovery Guidelines*.

In Victoria, there is scope for differentiation of datasets individually according to public good characteristics and positive spillovers. However, it is unclear to what extent this is practically applied.

9 Alternative models

This chapter examines a range of potential pricing and access models under the framework of principles and issues discussed above. The models are not fully specified to the point of being operational, but are conceptual for the purpose of the analysis. Pros and cons for each model are noted, although no recommendations of preferred models for achieving a stated package of outcomes or objectives are made out at this stage.

These models could be applied at an agency level or to a statutory authority such as Landgate. At the level that these models are considered, the type of entity exercising the pricing policy does not substantively change the analysis.

These models form the basis of the dynamic cost-benefit analysis that will be carried out in the second stage of this project. A summary of the models is presented in Table 5.

Table 5: Pricing and access models for analysis

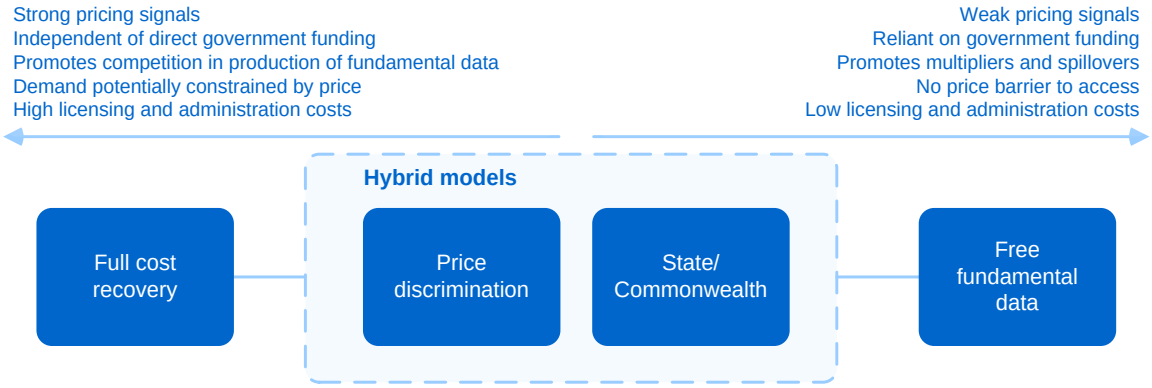
Model name	Fundamental data free	Price discrimination	Commonwealth / State	Full cost recovery
Raw data price (if available)	Marginal cost (free online)	Full cost to commercial users, free to non-commercial users	States supply data at full cost, Commonwealth at no cost	Full cost
Fundamental data price	Marginal cost (free online) for selected data sets	Full cost to commercial users; free to non-commercial users	Full cost from States; free from Commonwealth	Full cost
Value added data price	Full cost	Full cost	Full cost	Full cost
Funding	Fundamental data publicly funded. Value added products funded by data purchasers	A mix of public and private funding for fundamental data	States: 100% funded by data purchasers; Commonwealth: publicly funded	100% funded by data purchasers
Role for private sector	Competition in value adding	Direct competition at all stages of production (if feasible against natural monopoly)	Direct competition against States at all stages of production	Direct competition at all stages of production (if feasible against natural monopoly)

A spectrum of models

The full cost recovery and free fundamental data models represent the ends of the spectrum of pricing considerations and will allow for clear, comparative analysis of the costs and benefits of each polar extreme — that is, full cost recovery for fundamental data as opposed to supplying the data to all users at no cost (or the marginal cost of distribution). The advantages and disadvantages of these distinctly different approaches are summarised Figure 11 below.

The two hybrid models lie in the middle of this spectrum, with the differentiation between type of user or jurisdiction achieving a different balance of costs of benefits than the pure models. In the case of the price discrimination model, this may occur due to differences in willingness to pay, multiplier effect and positive externalities resulting from different uses. The rationale for the Commonwealth / State model lies in the different types of datasets produced across jurisdictions and the ability of the Commonwealth and States to obtain funding for spatial data products.

Figure 11: Pricing and access models identified for analysis



These models could be utilised to achieve the objectives discussed in section 6.1 to varying degrees. Each model involves tradeoffs between objectives, with different models potentially preferable depending on the specific objective to be achieved. A coarse assessment of the consistency of each model with the pricing and access objectives is shown in Table 6.

Table 6: Consistency of models with pricing and access objectives

Objective	Full cost recovery	Free fundamental data	Price discrimination	Commonwealth / State
Economic development				
Public policy support				
Generation of revenue				
Accountability				
Promotion of competition				
Privacy and national security				
Restriction on access for pricing				

Consistent | Partially consistent | Inconsistent

From this assessment, it can be seen that each model can be used to support any objective to differing degrees, with the exception of the free fundamental data model as a mode of achieving revenue objectives. Even that perspective could be considered limited if the free fundamental data model was used to leverage revenue for other value added spatial data products. The trade-off between objectives and models is one of degree or emphasis.

The remainder of this chapter sets out the models in more detail and discusses the pros and cons of each of the models. A summary of the pros and cons of the alternative models is summarised in Table 7.

Table 7: Pros and cons of pricing and access models identified for analysis

Model	Pros	Cons
Full cost recovery	Simple and transparent Pricing signals Facilitates competitive neutrality Sustainability of funding	Reduced multiplier effect Unable to consider public good characteristics and positive externalities Public policy decision making with reduced information
Free fundamental data	Increased multiplier effect Public good characteristics and positive externalities considered Efficient level of consumption Platform for innovation	Loss of revenue Inefficiency of government funds Loss of pricing feedback Direct user and beneficiary does not pay Prevention of competition in market for production of fundamental data
Price discrimination	Maintenance of revenue stream Pricing signals from commercial users Informed public policy decision making Positive externalities and other benefits from non-commercial use	Loss of pricing signals from public sector Inequity between commercial and non-commercial users Complexity and administrative costs Limited multiplier effect
Commonwealth / State model	Matches ability to raise funds and possibly a differing marginal cost of public funds Reflects role in spatial data industry and type of product produced	No prima facie case based on best practice policy reasons

9.1 Full cost recovery

The full cost recovery model involves the recovery of the total costs relating to spatial data from all users, including government. Pricing adjustments may also be made for competitive neutrality and a commercial rate of return. This model is akin to that applied by the Ordnance Survey before the release of OS OpenData in April 2010.

The need for government funding is minimal under the full cost recovery model.

Two iterations of the full cost recovery model will be examined: with one involving the release of raw data, also at full cost. This is in order to examine the duplication versus competition dynamic.

9.1.1 Pros

The full cost recovery model provides a simple, transparent method of pricing spatial data. As all direct users pay the costs, there will be signals as to the avoidable costs of serving consumers and the costs of the outputs consumed. The observed consumption decisions will send an efficiency signal to the land information agency about what is most valued by users. These signals can be used by the land information agencies to direct their efforts towards producing spatial data that is valued by customers. This provides a level of accountability in what spatial data the land information agency produces.

The full cost recovery pricing of spatial data allows the private sector to compete in the spatial data supply chain on an even footing. While some parts of this supply chain have natural monopoly characteristics, continued technological advances and reductions in fixed costs are opening up opportunities for competition in areas where competition was previously unviable. The full cost recovery model ensures that the private sector is not pushed out of any area through the provision of free data by a government source.

Assuming that the agency is able to effectively compete with the private sector, the full cost recovery model ensures sustainability of funding. Funding is not contingent on an assessment of value by government but rather through the clear signals of value by those purchasing the spatial data.

A variant of the model is to release raw data at full cost. This will create a competitive processing and value adding market. It would be expected that a range of parties would enter this market, with interest in raw data availability signalled by industry stakeholders during the consultations. The majority of industry survey participants stated that the government should collect raw and unrefined data and make it available to the market. This could result in a range of more tailored solutions to end-users than may be created by a single provider. This competition would drive innovation and efficiencies in the value adding sector.

Raw data can be made available more quickly and for lower cost than processed data. This allows for more up to date data to be available in the public arena, and where that raw data adequately serves the purposes of specific parties, allows them to use that data without waiting for the release of value added products. While processing time varies widely depending upon the dataset, one land information agency estimated that it takes around three weeks for triangulation and orthorectification of aerial photography and depending on the size of the area, between two days and four months to integrate raw data into the existing topographic dataset.

9.1.2 Cons

The full cost recovery model has a number of negative implications through the unavailability of data to those who are not willing or able to pay for it. In a commercial sense, the restriction on availability of the spatial data has the potential to reduce size of the multiplier effect and the total welfare from the spatial data. In one dimension of efficiency, there is under-consumption as price is greater than marginal cost.

The cost recovery policy in this model is applied at the agency level rather than the product level. As discussed in section 6.2.6, a uniform policy does not allow for goods

with public good characteristics to be distinguished from other goods offered by the agency.

Where there are public good characteristics or positive externalities to the spatial data, the group of beneficiaries is much wider than the narrow group of direct users that pay the full cost of the product. This may be considered to be inequitable.

If resources are not available for a specific government agency to purchase the spatial data, this can result in sub-optimal decision making. Distribution of data to all government parties where there is a near zero marginal cost of distribution would be an improvement for the whole of government. However, the availability of the data may be contingent on the pricing signals within government of the value of the data. If this is the case, cost recovery pricing may carry short term costs for decision making but will allow the data to be available in the future.

For the model variant involving the sale of raw data, a competitive value adding market may result in the duplication of value adding services in an area suitable for a natural monopoly. In a static sense, this is an inefficient outcome. The degree of this allocative inefficiency at a point in time may be mitigated or outweighed by dynamic considerations as competition may drive innovation and cost reductions over time that reduce the investment required in value adding products. It might also be asked whether the processing of the raw data into fundamental data results in duplication of processing or the production of a range of more highly tailored products.

9.2 Free fundamental data

The free fundamental data model involves pricing a set of fundamental data at the marginal cost of extraction and distribution (free online). This model is similar to that recommended by the Productivity Commission (2001) and the Commonwealth's Department of Finance and Administration *Cost Recovery Guidelines* (2005) and that adopted by the Australian Bureau of Statistics.

Under this model, fundamental data sets are released at marginal cost and licensed to allow distribution, re-use and value adding without restriction, subject to attribution of source (such as the Creative Commons Attribution licence). Value added products are priced at cost recovery or at commercial rates of return, with adjustments for competitive neutrality where required.

Production of the fundamental data sets sold at marginal cost is funded by government. Value added products are funded through revenue from their sale. There is no price discrimination to different users or uses.

Alternative iterations of this model could be considered with different subsets of fundamental spatial data available for marginal cost. This is based on the principle that pricing and access should be determined on a dataset by dataset basis rather than at an agency level. Identification of the appropriate data sets for marginal cost pricing will involve a cost-benefit analysis of each data set and consideration of the public good characteristics and positive externalities of each. This process is similar to that recommended by the Productivity Commission for identification of the basic information set.

9.2.1 Pros

The availability of fundamental data at the marginal cost of distribution can be expected to create a multiplier effect from the use of that data. Pricing at marginal cost will also allow the benefits from the public good characteristics and positive externalities of the fundamental spatial data to be realised. It could enhance scope for innovation, by ensuring the broadest possible array of users have access to the information.

Pricing at marginal cost will also lead to an efficiency level of consumption of those datasets so priced. An efficient level of consumption and realisation of the public good characteristics and positive externalities can be expected to increase social welfare.

This model may also generate some efficiency from reduced administrative costs. Once identified, the administrative costs associated with licensing and pricing of the basic information set are reduced.

The alternative iterations of the model whereby pricing policy is determined on a dataset by dataset basis ensure that the delineation between marginal cost pricing and cost recovery pricing occurs at an appropriate point.

9.2.2 Cons

The free fundamental data model results in lower revenue from sales of spatial data than the full cost recovery model. A failure by government to provide adequate funding to maintain the data will diminish the potential benefits of this model. The degree of revenue lost depends on where the line is drawn for the basic set of fundamental spatial data. As an example, the ABS lost around $3 million in revenue from putting basic data sets online for free but still receives around $14-$20 million annually from supplementary information data sets (Tam, 2009), with those supplementary datasets consisting mainly of products where additional work is undertaken to meet the demands of the client. The use of public funding to produce the fundamental spatial data also carries with it the inefficiency of raising funds through taxation.

The provision of free spatial data removes the feedback obtained through pricing as to what data to produce. This lack of feedback is an issue in relation to both interaction with private sector clients and control of internal government demand. While other methods of user interaction are available, pricing is reliable and not as susceptible to cheap talk (where a consumer claims a value of a product but they are unwilling to pay the price).

There may be some higher costs associated with this model, such as the higher costs associated with additional demand and the cost of determining which fundamental data sets should be made available at marginal cost. The private sector may also incur costs through lobbying for particular fundamental data sets to be included in the marginal cost package.

There are also equity issues, with the groups that benefit most gaining access to the data for marginal cost, yet all taxpayers pay. However, it may be argued that multiplier effects ultimately spread benefits to the entire community.

While the release of raw data could also be considered in this model, the release of fundamental spatial data for marginal cost is likely to prevent any other entrants into the initial processing market. The lack of competition in the processing of raw data, while potentially creating short term efficiencies through removing duplication, creates the

potential for dynamic inefficiency as cost and innovation pressures that exist in a competitive market are no longer present.

9.3 Price discrimination

The price discrimination model applies differential pricing according to the customer and use. This model is similar to that applied by Landgate in Western Australia.

Spatial data products are priced at full cost recovery for commercial customers, with possible adjustments for competitive neutrality and a commercial rate of return. Non-commercial users, including internal government users, are charged the marginal cost of extraction and distribution (free online) for the fundamental data set. Non-commercial users continue to pay for value added products.

Most of the funding for the spatial data comes from sales of products to commercial users. Government funding is required to fill the gap in revenue due to the free internal use of spatial data

9.3.1 Pros

The price discrimination model provides for the source of revenue for the production of fundamental spatial data to be maintained. It also allows for the generation of reliable signals from the private sector. This feedback can be used to shape the nature of the products produced for that sector with a clear indication provided that those products are of value.

The price discrimination model allows full use of the available fundamental spatial data for public policy decision making. If data are available, a failure to use it in decision making where it can add value is sub-optimal.

Use of the fundamental data in non-commercial areas also provides value, with charities gaining improved ability to service their constituents and citizens being provided with the data they require to actively engage with government. The price discrimination also allows this to occur without jeopardising revenue from commercial users.

9.3.2 Cons

While the price discrimination model provides clear pricing signals in the private sector, it lacks those signals within government. The lack of cost to government agencies removes any limit on their demands, leaving the land information agency in a position of trying to juggle competing demands without the allocation of resources that pricing would normally control. As the funding of all agencies is ultimately from the same Treasury source, pricing does not act as a perfect control within government. In this model, the accountability mechanisms contained within government budget processes could be used, although this lacks the clarity of a pricing signal.

The price discrimination model does have a funding gap, unless pricing for the private sector is designed to implicitly subsidise the non-commercial use (which carries with it equity issues). This funding gap carries similar implications to the other models, where a

failure of government to supply funding may affect the production and quality of the spatial data.

The discrimination between commercial and non-commercial uses also carries with it a degree of complexity and administrative costs. The distinction between commercial and non-commercial activities is not always transparent, and other criteria such as the public interest may be required. There is also a cost of compliance and enforcement.

The pricing of all spatial data for commercial users limits the multiplier effect. As a non-rivalrous good, broader dissemination will generate greater economic activity and pricing acts as an inherent barrier to this.

9.4 Commonwealth / State model

The Commonwealth / State model applies a hybrid of the above models across the States and Commonwealth. At the Commonwealth level, fundamental data are provided at the marginal cost of distribution (free online), as per the free fundamental data model. The States apply the full cost recovery model. The State / Commonwealth model in some ways represents the status quo.

At each level of government, the pros and cons of each model remain as they are described above. A number of other pros and cons result from this hybrid model.

9.4.1 Pros

The hybrid model matches the disparity in the ability to raise revenue between the States and Commonwealth. The Commonwealth has a broader taxation base than the States and as a result, has greater capacity to raise funds for the production of spatial data from sources other than the sale of that data. The differing taxation base may also result in the marginal cost of public funds differing between the states and Commonwealth. A higher marginal cost of public funds at the state level would result in higher costs of funding spatial data production and maintenance from public funds and make a cost recovery pricing policy more favourable.

The disparity between the States and the Commonwealth also extends to the role played in the spatial data industry. The States have a longer history in spatial data and a larger level of spatial data infrastructure, including data, that they have developed and need to maintain. This naturally results in increased funding requirements that may not be met from general revenue.

There are also some differences in the spatial data collected by the jurisdictions. A larger proportion of spatial data collected by the Commonwealth is project based and once collected, is a finished product free for distribution. Most state and territory level datasets and not static and require constant expenditure to maintain the dataset to the required standards. As a result, the implications of a reduction of funding and the avoidable costs associated with maintaining the datasets for distributions may vary between jurisdictions.

It is also possible that this hybrid model may be justified by differing public good characteristics or positive externalities associated with the datasets in each jurisdiction.

9.4.2 Cons

While there are differences in roles in the spatial data sector and the ability to fund spatial data between the Commonwealth and the States, there is no prima facie case or clear policy rationale for exercising different policies at each level. Unless a case can be made that the spatial data held at the Commonwealth level possesses different characteristics itself such that it plays a greater role in innovation or social benefit if distributed freely, the difference rests on imperfections in the exercise of internal funding rather than good policy.

10 Conclusion

There is a range of objectives that could be pursued in determining pricing and access policies, some of which are competing. The challenge for government and industry is to recognise the inherent trade-offs between some of these objectives, then select a pricing and access approach that offers the best overall outcome for the spatial data industry.

In addition, the following principles are identified for guiding the development of a pricing and access framework for spatial data.

- By default, government should impose no 'hard constraints' to access (that is, non-price constraints) unless there is a defensible public interest reason for constraining access.
- Pricing and access should promote efficiency in the production and consumption of spatial data.
- Prices and cost recovery policy should be adjusted to take into account the public good nature of fundamental spatial data and the possibility of positive spillovers from its use.
- Pricing and access should be equitable.
- Pricing and access policies should be consistent with competitive neutrality.
- Pricing and access policies should be applied to specific fundamental datasets or classes of data and not to an agency as a whole.

10.1 Stage 2 – cost benefit analysis

In Stage 2, the models examined in this report will be put under cost benefit analysis. These models will undergo the following stages of analysis:

Definition of pricing and access models and options: PwC will determine how the different cost components associated with the capture, maintenance and distribution of spatial data would be factored into the alternative pricing models. This report identified four models for assessment. A qualitative assessment of the pros and cons of these alternatives was summarised in Table 7.

Dynamic cost-benefit analysis of the models: PwC will examine the nature and magnitude of the costs and benefits of the models with the help of a number of case studies. The cost-benefit analysis will be conducted over a ten to fifteen year timeframe, which would allow dynamics to be incorporated and a net present value to be calculated for each model run.

Implementation considerations: In addition to economic efficiency criteria, a number of practical considerations may be able to be incorporated into the cost-benefit analysis. In other instances, these factors may need to be handled in a qualitative manner.

A report containing the economic analysis and evaluation of alternative models, together with recommendations, will be prepared and delivered to the steering committee at the culmination of the stage 2.

Appendices

Appendix A Glossary

Term	Definition
Avoidable costs	Costs that would be avoided if production of a particular output or service of a particular customer class was ceased
Basic information (product) set	Information products characterised by a high degree of non-rivalry and non-excludability to potential users (public good characteristics) and significant positive externalities
Competitive neutrality	Policy principle that requires prices charged by government businesses to reflect full cost attribution and to account for any competitive advantages and disadvantages of public ownership
Consumer welfare	Collective benefit derived by consumers of a product or service. Typically defined as the difference between the amount they are willing to pay and the price that is paid
Cost plus	Pricing model where the price is determined from the actual cost of production and includes an agreed mark-up or rate of return
Cost recovery	Pricing model where the price is determined with regard to all costs attributed to data production, that is, equal to average long-run costs
Creative Commons	A non-profit organisation that has built a range of free licences that allow content owners to specify which rights they retain in their works and which rights they will waive
Crown copyright	A form of copyright protection claimed by government and in Australia, defined in the *Copyright Act 1968*
Custodian	The body responsible for the development and management of a dataset, including determining the conditions of use and distribution of the dataset
Differential pricing	Pricing model where different customer groups or uses are charged different prices for the same or similar products

Term	Definition
Direct costs	Costs that can directly and unequivocally be attributed to an output
Economically efficient pricing	Setting prices to deliver the maximum social welfare benefit
Externality	Indirect (positive or negative) welfare effects of decisions to produce or consume on firms or individuals other than producers or consumers of the product
Fixed costs	Costs that remain unchanged irrespective of the volume of output produced. Equal to total costs minus variable costs.
Fundamental spatial data	An authoritative source of spatial data that is maintained to well defined quality standards and cannot be derived from another dataset
Indirect costs	Costs that are not directly attributable to an output and are often referred to as overheads
Intellectual property (IP) rights	Rights granted by law in relation to copyright, inventions, registered and unregistered trademarks, registered designs, and all other rights resulting from intellectual activity in the industrial, scientific, literary and artistic fields
Marginal cost of public funds	The collection, compliance and deadweight losses associated with raising tax revenues
Marginal cost pricing	Pricing model where the price is equal to the cost of supplying one extra unit of a good or service
Marginal cost	Cost of producing one additional unit of a good or service
Market failure	Situation where the characteristics of a market lead to inefficient resource allocation
Natural monopoly	Situation where a single firm can meet market needs more efficiently due to high fixed costs and low variable costs

Term	Definition
Non-excludability	Where after provision of a good or service to one consumer, other consumers cannot be excluded from also using the good or service
Non-rivalry	Where provision of a good or service to one person does not diminish the availability of the good or service to others
Price discrimination	Practice of charging separate customer groups or uses different prices for the same or similar products
Price elasticity of demand	Responsiveness of the demand for a product or service to a change in its price
Public good	Good or service characterised by a high degree of non-rivalry and non-excludability
Public sector information (PSI)	Information products and services that are generated, created, collected, processed, preserved, maintained, disseminated, or funded by a public sector organisation
Ramsey pricing	Pricing regime which maximises social welfare by pricing according to the demand elasticity of different customer groups through price discrimination
Raw data	Data in its most basic state without any additional manipulation or analysis
Spatial data	Data about the location and attributes of features that are on, above or beneath the surface of the earth. Also referred to as land data or geographic data.
Spillover	Indirect (positive or negative) welfare effects of decisions to produce or consume on firms or individuals other than producers or consumers of the product
Value added data	Raw or fundamental data that is manipulated, edited, compiled or otherwise processed to enhance its value and facilitate its use and effectiveness for the end user

Term	Definition
Value added re-seller (VAR)	Business entity that resells data, after having added value to the product
Variable costs	Costs that change in proportion to changes in the quantity of output produced

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Appendix C Project steering committee and stakeholders

Project steering committee

The project is overseen by a Steering Committee comprising the following members:

Mike Bradford (Steering Committee Chair) –Chief Executive, Landgate (Western Australia)

Ian Hyde, Executive Director, Strategy and Reform, Landgate (Western Australia)

Kate Kent, General Manager Information and Land Services, Department of Primary Industries, Parks, Water & Environment (Tasmania)

Liz Marchant, Executive Director, ANZLIC – The Spatial Information Council

Des Mooney, Deputy Director General and General Manager, Land and Property Information Division, Land and Property Management Authority (New South Wales)

Dan Paull, Chief Executive Officer, PSMA Australia

Mike Ridout, Communications Director, CRCSI

Ben Searle, General Manager, Office of Spatial Data Management

Elizabeth Thomas, Director, Strategy and Projects, Spatial Information Infrastructure, Department of Sustainability and Environment (Victoria)

Bruce Thompson, Director, Spatial Information Infrastructure, Department of Sustainability and Environment (Victoria)

Consultation: face-to-face, workshop and survey

During the development of the Stage 1 report, consultation was carried out with public and private sector parties through face-to-face meetings, a workshop to review the results of the face-to-face consultations and an industry survey (a copy of the industry survey questions is contained in Appendix D). Through this process, the following parties have provided input into this report:

Land information agencies

Department of Environment and Resource Management (Queensland)

Department of Primary Industries, Parks, Water and Environment (Tasmania), Information and Land Services

Department of Sustainability and Environment (Victoria), Spatial Information Infrastructure

Land and Property Management Authority (LPMA), Land and Property Information

Landgate

Land Information New Zealand, Policy Group

PSMA Australia

Other government bodies

ANZLIC – The Spatial Information Council

Australian Bureau of Statistics

Australian Government Information Management Office (AGIMO)

Bureau of Meteorology, Water Data Services

Department of Broadband, Communications and Digital Economy

Department of Innovation, Industry and Regional Development (Victoria), Innovation and Technology Capabilities

Office of Spatial data Management

Western Australian Land Information System (WALIS) members

Other stakeholders

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AAM Pty Ltd

Cooperative Research Centre for Spatial Information (CRCSI)

Experian QAS

Geomatic Technologies

Glenorchy City Council

Lester Franks

MapData Sciences

Nick Gruen, Chair Government 2.0 Taskforce

NuMaps

Omnilink

Pitney Bowes Business Insight

Sinclair Knight Merz Pty Ltd

Spatial Information Business Association (SIBA)

Spatial Vision

Terranean Mapping Technologies

Victorian Spatial Council

Appendix D Industry survey questionnaire

This appendix contains a copy of the industry survey questionnaire that was sent to approximately 40 organisations. It also contains a selection of results.

Introduction

PwC has been engaged by the ANZLIC – the Spatial Information Council to undertake an economic assessment of alternative pricing and access models for managing public sector spatial information. The objective of the study is to assess the economic costs and benefits of alternative pricing and access models, particularly in regard to the implications of these models on the long term sustainability of the supply of quality data, services and products from both land information agencies and private resellers.

The focus of the project is on fundamental data – datasets that are an "authoritative source" for public and private sector users – as opposed to unrefined data dumps.

As part of this study, PwC is conducting an on-line survey of major businesses and industry associations in the spatial data sector. The survey is also being sent to a sample of research and development and educational institutions that are known to be heavy users of spatial data. The purpose of the survey is to understand:

- the pricing and access arrangements under which spatial information is currently obtained;
- stakeholder experience and views of the pros and cons on different access and pricing policies; and
- the emerging needs and priorities of various users (both intermediaries and their customers) against the backdrop of recent and ongoing advances in technology.

Your survey responses can remain anonymous and survey information will be treated in strict confidence.

Survey Instructions

Depending on your organisation type, some of the questions may not be applicable. In these instances, please select the 'not relevant' box.

Questions

About your organisation

1. What is the name of your firm or organisation?

   Or tick the box if you wish to remain anonymous.

2. Which of the following options best describes the nature of your business?

    Data value adding for resale

    Broker of wholesale data

    Developer of application software

    Education and public research

    Commercial research and development

    Industry representation / peak body

    Consultant

    Other (please specify)

3. What is your annual turnover before tax?

    0 to $0.5 million

    $0.5 to $1 million

    $1 to $2 million

    $2 to $5 million

    $5 to $10 million

    Greater than $10 million

    Not relevant

4. Approximately how many employees do you have (full time equivalents)?

    Enter a figure

5. For what specific purpose do you use spatial data (e.g. software applications, decision tools, positioning systems, marketing, property valuation etc.)?

6. What type of fundamental spatial data do you use? [Tick more than one if required]

   Geodetic control

   Earth's surface / elevation

   Property

   Administration (urban / rural / postcode boundaries)

   Natural environment

   Transportation

   Socio-economic

   Built environment

   Aerial and satellite images

   Other (please specify)

7. Who do you predominantly obtain fundamental spatial data from? [Tick more than one if required]

   Private value added resellers

   Private data brokers

   State land information agencies

   Commonwealth agencies

8. Which jurisdictions do you predominantly obtain fundamental spatial data from? [Tick more than one if required]

   New South Wales

   Victoria

   Queensland

   Western Australia

   South Australia

   Tasmania

   Australian Capital Territory

   Northern Territory

   Commonwealth

   New Zealand

9. Do you have a choice of supplier for your spatial data needs (that is, same data from multiple sources)?

    Yes

    No

    Not relevant

    Please provide brief details of any concerns.

10. Approximately how much would your business or organisation spend on access to fundamental spatial data each year?

    Enter a number ($)

    Not relevant

    Don't know

11. Approximately what percentage of your total production costs is made up of the cost of access to fundamental spatial data?

    Enter a number (%)

    Not relevant

    Don't know

12. How does your organisation license its data based products?

    Restrictive copyright

    Creative commons

    Do not licence

    Other (please specify)

    Not relevant

The Spatial Information Market

13. Who are your main customers for data products and services? [Tick more than one if required]

    Real estate sector / valuers / surveyors

    Mining

    Transport and freight

    Civil engineering / construction

    Agricultural / forestry sector

    Software developers / IT

    Education sector

    Social or health sectors

    Government agencies

    Not for profit organisations

    Other (please specify)

    Not relevant (do not supply to customers)

14. How would you rate the strength of competition in the market serviced by your firm?

    Very competitive

    Moderately competitive

    Weakly competitive

    We are the sole supplier

    Don't know

    Not relevant

15. What is the main source of your competition?

    Government land information agencies

    Other government agencies or publicly funded authorities

    Private business

    Not relevant

16. Do you believe that there is a level playing field between the private and public sector with respect to the cost at which **fundamental spatial data** are supplied to the market?

    Yes

    No (Please explain)

    N/A, I obtain the spatial data free of charge

17. Do you believe that there is a level playing field between the private and public sector in production of **value added services**?

    Yes

    No (Please explain)

    N/A, I obtain the spatial data free of charge

18. What do you see as government's role in the spatial data field? [Tick more than one if required]

    No role to play.

    Collecting unrefined/raw data and making it available to the market

    Collecting unrefined/raw data and undertaking a value add process to make it fit for purpose to market

    Coordination (such as matching buyers to sellers)

    Quality control

    Just meeting public policy needs for data

    Other (please specify)

    Don't know.

Current Pricing and Access Arrangements

19. Under what pricing arrangements do you obtain the bulk of your fundamental spatial data?

    Free

    At cost of extraction / distribution (marginal cost)

    At market price

    Negotiated commercial price

    At a commercial “listed” price

    Other, please specify

    Not relevant

20. Do current spatial information access and pricing arrangements meet your needs and expectations?

    Yes – completely (go to Q22)

    Yes – somewhat (go to Q21)

    No – not satisfactory (go to Q21)

    Don’t know

21. What are the main problems you experience in obtaining fundamental spatial data? [Tick more than one if required]

    Quality (e.g. accuracy, currency) issues

    Restricted access

    Cost

    Inadequate data coverage

    Inconsistent pricing and access policies across different jurisdictions

    Restrictive licensing requirements

    Lack of choice of data suppliers

    Uncertainty and lack of transparency about pricing

    Bureaucratic process

    Other

    If you wish to provide further comments to support your response above, please do so in the space below.

22. For your organisation, is quality (e.g. accuracy, currency) of data more important than price?

    Yes

    No

23. What is more valuable to your organisation?

    Data that is accurate in terms of its attribute information

    Data that is spatially accurate (location)

    Data that is current

    Integrated combination of all the above and fit for purpose

    Unrefined/raw data

    Other

24. In your experience, is price differentiation for fundamental spatial data between different user groups or uses appropriately applied?

    Yes

    No (Please explain)

    Don't know

25. Under what form of licensing arrangement do you normally obtain your data?

    Restricted

    Somewhat restricted

    No licensing arrangement

26. In circumstances where a licensing arrangement applies, under what conditions may you re-use or resell the spatial data?

27. In circumstances where a licensing arrangement applies, what royalty arrangements apply?

28. Do you believe that the licensing restrictions are adequately and fairly enforced?

    Yes

    No

    Not applicable

29. If a uniform approach to licensing of fundamental data supplied by government agencies was adopted across Australia that allows re-use and resale with no restrictions or royalties, what do you expect the impact would be on:

    a. your organisation;

    b. the spatial data industry more generally.

30. What is the impact of the current pricing and access arrangements on innovation? What alternative pricing and access arrangements could enhance the level of innovation?

Technological Change

31. What do you consider to be the likely impact of technological changes to the **supply** of fundamental spatial data over the next 5 to 10 years? [Tick more than one if required]

    Lower access and distribution cost

    Better quality

    Larger volumes of data

    Trend towards private sector supply as opposed to government

    Better coverage of data sets

    Little impact

    Don't know

    If you wish to provide further comments to support your response above, please do so in the space below.

32. What do you anticipate will be the impact of changing technology on the **demand** for spatial data products and services products **by your firm** over the next 5 to 10 years? [Tick more than one if required]

    New demands for quality

    Changing type of data

    Increased volumes of data

    Changing customer base

    Trends towards vertical integration (large end users also data producers)

    Other

    If you wish to provide further comments to support your response above, please do so in the space below.

33. What changes might be needed to current access and pricing arrangements in the face of technological changes in the supply and distribution of fundamental spatial data?

Policy Alternatives

34. If the price of fundamental spatial data currently used by your organisation was to **rise** by 20 per cent (with no change in quality, i.e. all else being equal), how would your use of spatial data change? [Tick more than one if required]

    No change

    Reduce the currency of the spatial data that you use

    Reduce the volume of the spatial data that you use

    Reduce the resolution of the spatial data that you use

    Change the type of data that you use

    Reduce your level of output

    Not relevant

    If you wish to provide further comments to support your response above, please do so in the space below.

    Please note that this question is to be used to analyse price sensitivity and is not intended to represent any policy under consideration.

35. If the price of fundamental spatial data was to **fall** by 20 per cent (with no change in quality, i.e. all else being equal), how would your use of spatial data change? [Tick more than one if required]

    No change

    Increase the currency of the spatial data that you use

    Increase the volume of the spatial data that you use

    Increase the resolution of the spatial data that you use

    Change the type of data that you use

    Increase your level of output

    Not relevant

    If you wish to provide further comments to support your response above, please do so in the space below.

    Please note that this question is to be used to analyse price sensitivity and is not intended to represent any policy under consideration.

36. What pricing model for the supply of fundamental spatial data by government do you think is the most appropriate and sustainable for the spatial data industry?

    At cost of extraction / distribution (marginal cost)

    Full cost recovery

    Commercial rate of return (full cost recovery plus mark-up)

    Flexible combination of all of the above

    Don't know

If you wish to provide further comments to support your response above, please do so in the space below.

37. Who should pay for the production, maintenance and distribution of government sourced spatial data?

    Fully government funded

    Commercial users who benefit from the data

    All users (including those who use the data for non-commercial purposes, i.e. public research)

    Mix of public and private funding

    Don't know

    If you wish to provide further comments to support your response above, please do so in the space below.

38. What do you consider will be the effect of adoption of your preferred pricing model on the funding, supply and quality of fundamental spatial data?

39. Please tick this box if we may contact you further in relation to your answers to this survey.

Summary of survey responses

Figure 12: How would you rate the strength of competition in the market serviced by your firm?

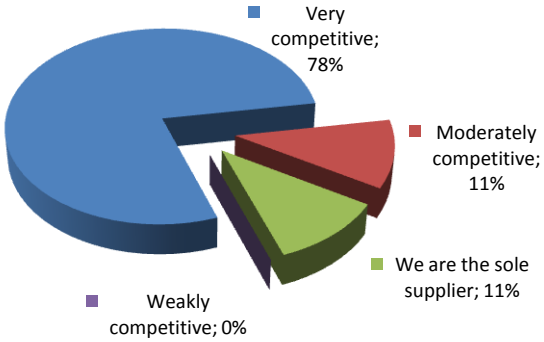


Figure 13: Do you believe that there is a level playing field between the private and public sector with respect to the cost at which fundamental spatial data are supplied to the market?

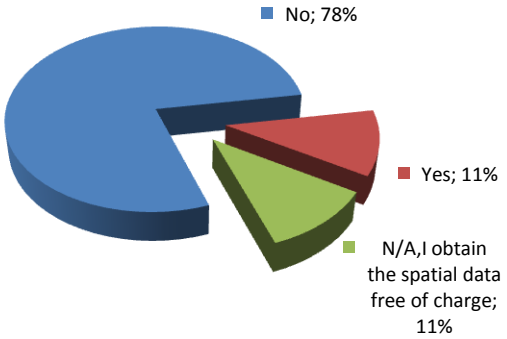


Figure 14: Do you believe that there is a level playing field between the private and public sector in production of value added services?

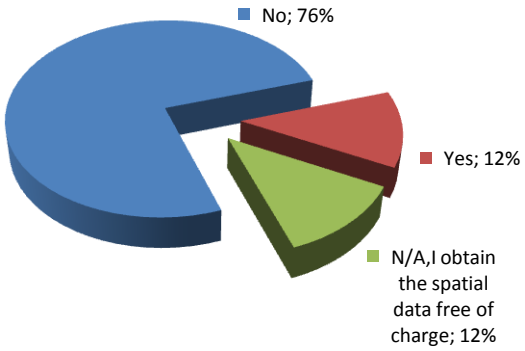


Figure 15: What do you see as government's role in the spatial data field? [Tick more than one if required]

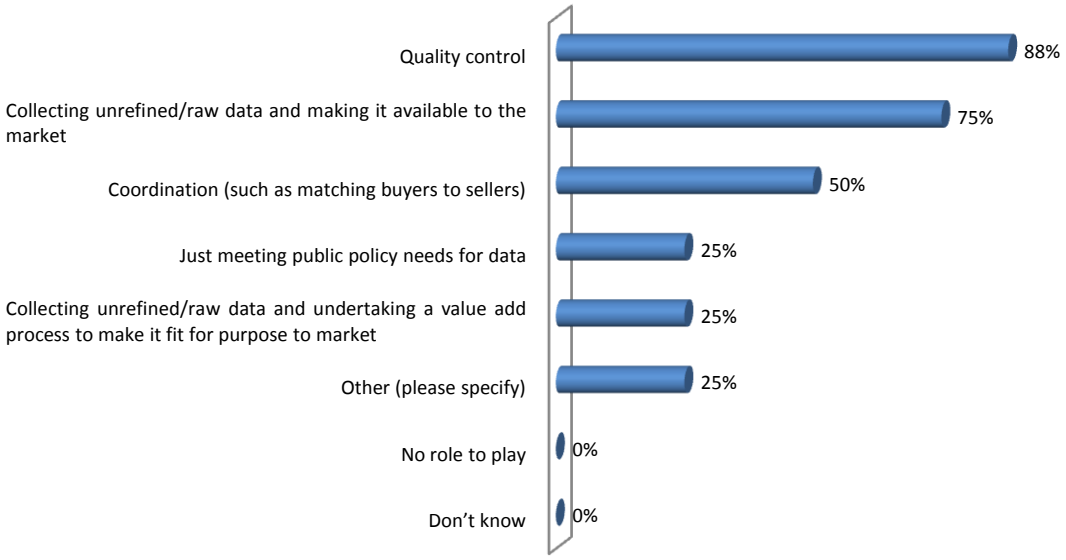


Figure 16: What are the main problems you experience in obtaining fundamental spatial data? [Tick more than one if required]

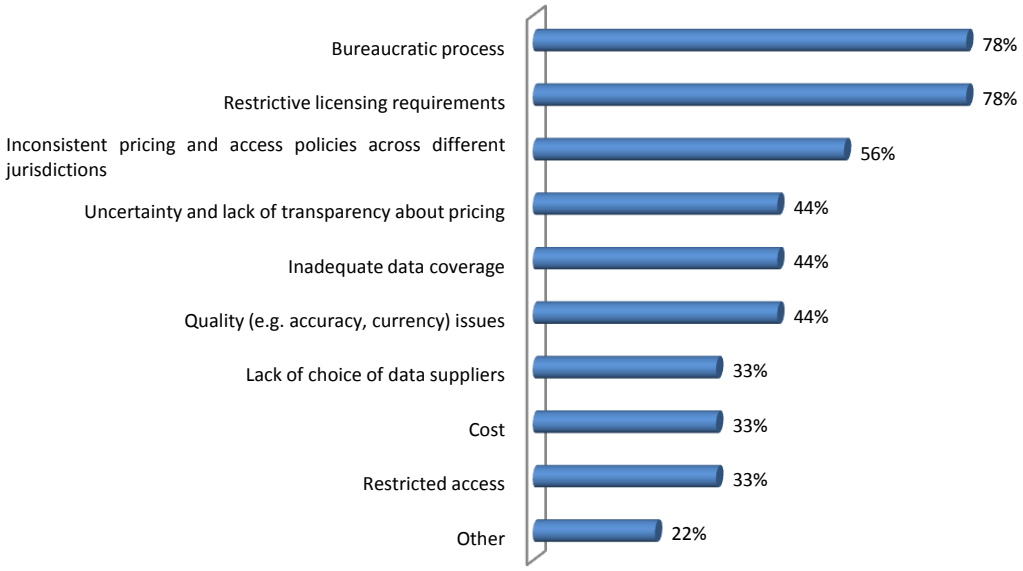


Figure 17: For your organisation, is quality (e.g. accuracy, currency) of data more important than price?

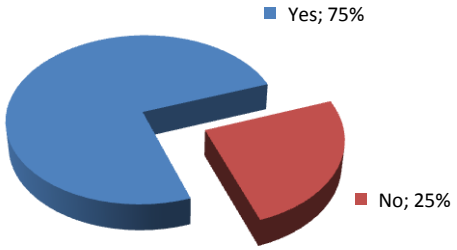


Figure 18: What pricing model for the supply of fundamental spatial data by government do you think is the most appropriate and sustainable for the spatial data industry?

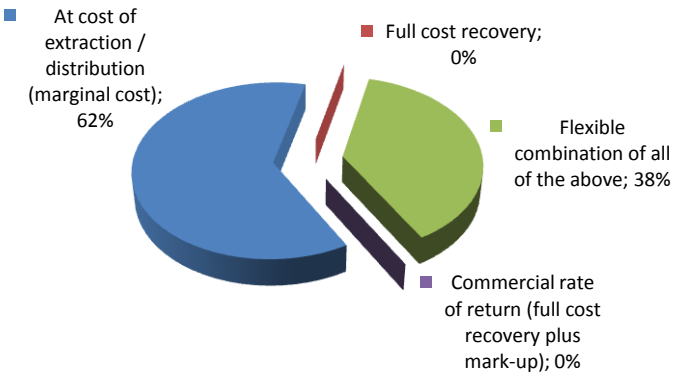
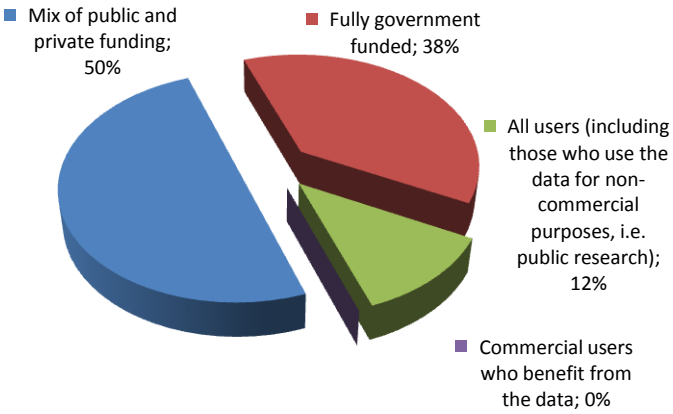


Figure 19: Who should pay for the production, maintenance and distribution of government sourced spatial data?



Appendix E Literature Summaries

ACIL Tasman, *Spatial Information in the New Zealand Economy – Realising Productivity Gains*, Prepared for Land Information New Zealand, Department of Conservation and Ministry of Economic Development, 2009

The report was commissioned by Land Information New Zealand, the New Zealand Department of Conservation, and the Ministry of Economic Development NZ. The study objectives were to:

- describe how spatial data are used across sectors of New Zealand's economy
- describe and quantify the value of spatial data in the economy
- estimates the gains available from removing barriers to spatial data making a greater contribution to productivity
- describes and estimates the value of greater use of spatial data to innovation and product markets.

ACIL Tasman found that:

- The use and re-use of spatial data have added an estimated $1.2 billion in productivity related benefits to the New Zealand economy in 2008.
- A range of barriers to the adoption of spatial data have constrained uptake and limited the ability to reap additional benefits in NZ, including:
  - problems in accessing data
  - inconsistency in data standards
  - a general lack of skills and knowledge relating to modern spatial data technology.
- Removal of key barriers would add $481 million in productivity related benefits, generating at least $100 million in government revenue. The cost of barriers will increase annually as demand for spatial data continues to grow.

The study recommended:

- solving the technical issues about exposing spatial data to the web in a few agencies and then replicating the solutions more widely including through the use of open source software
- requiring government departments and local authorities to make their spatial data available at marginal cost (which would be zero in case of web based delivery)
- providing technical elements of an SDI that other parties will not make available which could include spatial standards, metadata, and catalogue and registry functions.

ACIL Tasman, The Value Of Spatial Information - The Impact of Modern Spatial Information Technologies on the Australian Economy, Prepared for the CRC for Spatial Information and ANZLIC – the Spatial Information Council, 2008

The study, commissioned by the Cooperative Research Centre for Spatial Information, found that the direct impacts of the spatial data industry are:

- a contribution between $6.43 billion and $12.57 billion (equating to 0.6 and 1.2 percent) to the Gross Domestic Product (GDP)
- an increase in household consumption between $3.57 billion and $6.87 billion on a cumulative basis
- an increase in investment between $1.73 billion and $3.69 billion on a cumulative basis
- an increase in real wages of 0.60% to 1.12% than they would otherwise have been
- a positive impact on the trade balance:
  - an increase in exports between $1.26 billion and $2.30 billion
  - an increase in imports between $1.18 billion and $2.23 billion

Constraints on access to data are estimated to have reduced the direct productivity impacts in certain sectors by between 5 and 15 percent. This could have resulted in the GDP contribution and consumption being around 7 percent (around $0.5 billion) lower in 2006-07 than it might otherwise have been. The main factors of inefficient access are:

- availability of fundamental data: Business expressed concern that some applications are being constrained by availability and access to data relative to the quantity and quality of data available to overseas competitors.
- adequacy of spatial data infrastructure: Spatial data are fragmented at each level of government, with the lack of a whole-of-government approach and the inadequate engagement between governments and industry has consequences for the growth of the spatial data industry.
- consistency of access arrangements: ANZLIC's guidelines for best practice in enabling access to spatial data are not uniformly implemented.
- fitness for purpose: Data quality has progressed but metadata remains in many formats and are currently not totally valid.
- national licensing: Current licensing practices for the distribution and use of data have not kept up with the pace of technology.
- pricing: The principles for pricing fundamental data set out by the Productivity Commission in 2001 have not been implemented by all jurisdictions and fundamental data are often issued above the cost of its distribution.

The report also addressed what factors will be driving the industry growth over the medium to long term. These were stated to be:

- in the medium term (five years) by:
  - increased adoption in existing applications
  - introduction of new applications
  - increased penetration into non traditional sectors and new markets
  - increased use by government in delivery of services.
- in the longer term (ten years) by:
  - the falling cost of acquiring data
  - continuing developments of computing power making more applications and richer data analysis possible
  - the arrival of spatial technologies into the consumer mainstream.

Department for Communities and Local Government, Policy Options for Geographic Information from Ordnance Survey - Consultation, London, 2009

The UK government proposed to make certain Ordnance Survey datasets available for free and with no restrictions on re-use. Ordnance Survey is a national mapping agency that collects, maintains and distributes spatial data. Operations of the agency are funded though revenue generated from its activities.

A public consultation process was initiated by the Department for Communities and Local Government. The Department released this consultation document to seek feedback on how best to implement the proposal considering strategic objectives for Ordnance Survey and context of the wider geographic data market.

The report outlines advantages and shortcomings of the following three options proposed for discussion:

- continue to deliver integrated data and products priced in a way that allows the agency to cover its costs and fund its investment program without requiring additional contributions from government
- release licensing constraints on large scale data effectively making all large- and smaller-scale data available for free and without restriction
- implement a staged transition from current business strategy including
- a release of a selection of mid- and small-scale products for free and with no restrictions on re-use
- correct the existing substantial imbalance between public and private sector prices for geographic data
- move towards tighter contracting arrangements\
- bring forward investments designed to realise long-term efficiency savings for government and other customers
- secure closer oversight and challenge from government's ownership function together with a move to segmental accounting in order to enhance transparency.

Department of Communities and Local Government, *Policy Options for Geographic Information from Ordnance Survey – Consultation: Government Response*, London, 2010

The Government announced that from 1 April 2010 a range of Ordnance Survey data and products would be released for free. This followed consultations around three potential models: keeping the self-funded licensing model; releasing licensing constraints on large scale data or a staged transition to the second option.

This package of data to be released for no charge is known as OS OpenData. OS OpenData includes the following products:

- OS Street View, a 10,000 scale raster product
- 1:50,000 scale gazetteer
- 1:250,000 scale colour raster
- OS Locator, a searchable gazetteer of road names
- Boundary-Line, administrative and electoral boundary data at a nominal scale of 1:10,000
- Code-Point Open, which provides the location of postcode units
- Meridian 2, a mid-scale digital representation of the UK
- Strategi, a detailed digital map derived from 1:250,000 scale topographic database
- Miniscale, a 1:1,000,000 scale raster product
- OS VectorMap District
- Land-Form PANORAMA, a 1:50,000 digital height product.

The Government also indicated its intention to enter into a commercial relationship with Ordnance Survey to provide goods and services to government under a centrally funded agreement that would allow the Government to make data available from ordnance Survey free at the point of use to public sector bodies.

Department of Industry, Tourism and Resources (DITR), Review of the Implementation of the Spatial Information Industry Action Agenda and the Spatial Data Access and Pricing Policy, Commonwealth Government, December 2004

The Department of Industry, Tourism and Resources (DITR) conducted a review of the implementation of the Spatial Information Industry Action Agenda (SIIAA) to meet formal requirements. The appropriateness, effectiveness and efficiency of the administrative implementing arrangements for the Spatial Data Access and Pricing (SDAP) Policy was also appraised as both Commonwealth initiatives were instigated as complementary measures.

The review concludes that the administrative structure recommended has been appropriately implemented to effectively and efficiently achieve the aims of the policy. However, a number of access and pricing issues remain, including no consistent approach to pricing and access:

- between the Commonwealth and the jurisdictions
- amongst the jurisdictions themselves: Some jurisdictions place a higher priority on cost recovery, others on accessibility.
- amongst different federal custodian agencies: There is also tension over the scope of the terms ‘spatial information’ and ‘spatial statistics’. The spatial data community’s interpretation of spatial data feeds a view that a wider range of statistical data should be available under the SDAP Policy; this view is not shared by the Australian Bureau of Statistics.

It was also found that the public sector continues to dominate the supply and demand markets for spatial data and accounts for the majority of expenditure on products, services and data.

Economic Development and Infrastructure Committee, *Inquiry into Improving Access to Victorian Public Sector Information and Data*, Parliament of Victoria, Melbourne, 2008.

The report is a result of inquiry of the Economic Development and Infrastructure Committee into 'the benefits and costs to Victoria from maximising access to and use of public sector information for commercial and non-commercial purposes'.

The following potential economic and social benefits of improved provision and sharing of public sector information (PSI) are identified in the report:

- increased commercial activity from the use of PSI
- commercial efficiency improvements (e.g. improved accuracy of market forecasts and more accurate decision making)
- government efficiency improvements (e.g. more informed decision-making and policy development processes)
- innovation
- potential for improved transparency and social engagement.

Considering the benefits of improved access to PSI, it is suggested that departments should be encouraged to identify material appropriate for publishing on their websites. A systematic approach should be applied for determining the release of PSI. Criteria to restrict access may include privacy restrictions, secrecy provision, existing contractual or funding arrangements and incomplete datasets. The report notes that spatial data was identified in the submissions as "particularly suited to release under strategies for improved access to PSI".

It is concluded that the application of no cost or marginal cost pricing to a basic information data set is the most effective method to achieve economic efficiency. The basic information data sets include data products possessing public good characteristics, positive spillover effects, or that are required for other public policy purposes of the government.[13]

Cost recovery pricing is appropriate when data products do not form part of governments' basic information product set. Partial cost recovery is not supported as a suitable policy as it requires government departments to assess the level of public and private benefits involved in each product in order to apply an appropriate level of cost recovery.

The report supports a view that the role of government in adding value to PSI for commercial purposes should be limited, with the private sector a more appropriate means to add value through the creation of new products and services. The government role is seen as a provider of PSI to improve social outcomes and promote economic growth though generating commercial activities.

[13] This definition was obtained from the Productivity Commission's Cost Recovery Guidelines (2001).

Government 2.0 Taskforce, *Engage – Getting on with Government 2.0*, Canberra, 2009

The Government 2.0 Taskforce was formed as a result of 'increased interest by governments worldwide in the potential uses of public sector information and online engagement'. The Taskforce comprises 15 members from government, business (including Google and Microsoft), academia, and cultural institutions. The agenda items of the Taskforce were

- to encourage the use of Web 2.0 tools and approaches across government
- to promote leadership, policy and governance to achieve necessary shifts in public sector culture and practice
- to promote open access to public sector information (PSI).

The Government 2.0 Taskforce's final report, *Engage: Getting on with Government 2.0*, was delivered to the Australian Government on December 22nd 2009.

The Taskforce found that the most economically efficient price to make PSI available to others is the marginal cost of doing so.

The principles of open access to PSI:

- free
- based on open standards
- easily discoverable
- understandable
- machine-readable
- freely reusable and transformable.

The open access will

- enhance accountability of 'government and elsewhere'
- can increase productivity (economic value)
- allowed community participation (social value)

The report endorses principles for PSI adopted by the Organisation of Economic Co-operation and Development (OECD) Council in the *Recommendation of the OECD Council for enhanced access and more effective use of public sector information*

Licensing issues are also discussed. Creative Commons Attribution should be used as the default licence.

National Geospatial Advisory Committee, *The Changing Geospatial Landscape*, Washington D.C., 2009

The white paper describes the changes and advancements related to geospatial technology over the past 30 years. The report was published by the National Geospatial Advisory Committee (NGAC) to set a context for future deliberations about current spatial data policies and programs in the US.

The paper demonstrates a changed role of the government in the spatial data industry. The federal government has shifted from being the primary provider of geographic data to a major consumer while the involvement of private sector participants and state and local governments in data provision has increased. The federal government policy of placing data in the public domain has enabled the change in stakeholders' roles. Advances in technology have extended the magnitude of private sector involvement altering the overall market environment. New technology eliminated many traditional barriers to participation in the geospatial data industry. For example, the development of the Internet allowed geographic information technology to be incorporated into main stream applications using web-based approaches. The ability of networks to link to remote servers has fostered the development of mobile and location based services in addition to services provided by traditional geographic information system (GIS) professionals.

The white paper recognises a need to re-examine the relationship between data providers and users as the existing arrangements no longer reflect the new marketplace, where data assets are controlled by private companies or local governments. The Federal government needs to adopt innovative policies to continue supporting dynamic and robust development of the spatial data industry.

Ordnance Survey, *International Comparison of Geographical Information Trading Models*, Prepared for the Department for Communities and Local Governments, London, 2008

The study analyses trading models of national mapping agencies in Australia, Canada, France, Netherlands, Norway, New Zealand, Sweden, United States and Great Britain. The models are compared across such factors as an agency status, business model, sources of income, main areas of activities, types of products and data, ways of data dissemination and types of customers, users and uses.

The overall conclusion of the report is that no single model can be identified as desirable for implementation in every country. A model successful in one country may not be equally successful elsewhere due to different economic, social, policy and physical geography contexts.

Studies of the current arrangements suggest that:

- No national mapping agency provides up-to-date large scale data for free.
- Free data are a by-product of statutory activities and is collected to meet a specific need.
- Cost of geographic data is not the only or major factor in promoting data usage.

Furthermore, analysis of the trading models establishes strong correlations between the following factors.

- Level of government funding and the pricing policy: Agencies with a market based pricing policy derive a lower percentage of their income from government funds, while agencies that provide data for free, such as those in the United States and Canada, are fully funded by the government.
- Pricing policy and the currency of data: There is a difference between the currency of the data from countries that provide it for free and those countries that charge for data. For instance, the United States and Canada provide free small scale topographic data but it is on average 10 to 20 years old. However, the report also notes that these national mapping agencies are obliged to produce detailed up-to-scale data only for areas rich in natural resources.

Pollock R., D. Newbery And L. Bently, *Models of Public Sector Information Provision via Trading Funds*, Prepared for the Department for Business, Enterprise and Regulatory Reform and HM Treasury, Cambridge, 2008

The study analyses the impact of adopting different pricing models for the provision of public sector information by the UK's trading funds. The impact is assessed in terms of the cost and benefit for society (producers, consumers and the wider information market) and the effect on government revenue.

The scope is limited to the six largest trading funds which collectively account for 70 percent of the estimated total annual income from UK Public Information Holders. Trading funds are government-owned agencies that are required to cover a majority of their costs by income obtained from their activities.

The study examines the following models:

- profit-maximisation: setting a price to maximise profit given the demand faced by the trading fund
- average cost (cost-recovery): setting a price equal to average long-run costs (including for example all fixed costs related to data production)
- marginal cost: setting a price equal to the marginal cost of supplying data
- zero cost: setting a price equal to zero.

In the paper, the pricing models are compared pair-wise: profit-maximising versus average cost, average versus marginal cost, and marginal versus zero cost.

The authors conclude that a socially optimal policy would involve:

- leaving the charging regimes for many (probably most) products[14] unchanged (at cost recovery)
- moving to marginal cost[15] charging for a subset of products (for which sufficient information was available to allow an adequate analysis), roughly approximating to the bulk 'unrefined' digital category[16].

Marginal cost pricing would improve welfare of the society (if implemented). The study estimated costs and benefits of adopting the marginal cost model for each fund individually (in dollar terms) and found that the overall benefit of doing so outweighed the cost. In addition, the analysis suggests that adopting the marginal cost pricing scheme will ensure that organisations other than trading funds will have access to unrefined ('upstream') data at marginal cost, increasing competition and promoting efficiency and innovation. However, marginal cost pricing may not always be preferable.

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[14] Refined products built on unrefined data

[15] For digital products marginal costs is approximately zero.

[16] The typical unrefined (raw) data are meteorology, cadastral and spatial, hydrography, land registration, companies information and driver and vehicle licensing.20

For some trading funds additional direct assistance would be required to cover shortfalls estimated to vary from ‘limited’ to ‘substantially large’ depending on the proportion of revenue received from provision of the bulk unrefined products.

A change should not adversely affect the performance of trading funds in terms of efficiency or data quality. However, a suitable governance and regulatory structure is essential to realise the benefits from the change as it is a primary determinant of trading fund performance.

Productivity Commission, *Cost Recovery by Government Agencies*, Report No. 15, Ausinfo, Canberra, 2001

The Productivity Commission's inquiry into cost recovery arrangements across Commonwealth agencies found that most cost recovery arrangements are ad hoc, lack transparency and have poor accountability and review mechanisms. Furthermore, the arrangements are inconsistent with sound economic principles and often create perverse financial incentives incompatible with overarching government objectives.

The Commission stated that cost recovery should be based on the following principles:

- Cost recovery should be implemented for economic efficiency reasons, not purely to raise revenue.
- Cost recovery should be consistent with broader policy objectives.
- Cost recovery arrangements should not suppress competition and innovation.

Operational and design principles that should be adopted included:

- using fees for service where possible
- applying cost recovery to activities, not agencies
- not using targets
- not using cost recovery to finance unrelated government objectives, policy development, ministerial or parliamentary services, or meeting international obligations
- avoiding cross-subsidies
- ensuring transparency and accountability.

In relation to information agencies, the report recommends general taxation revenue as a funding source for a basic product set that should be defined by information agencies in collaboration with the Government. The set includes data products that possess:

- public good characteristics
- significant positive spillovers
- that are required for other Government policy reasons.

Additional data products should be classified into three broad categories and priced accordingly:

- dissemination of existing products at marginal cost
- incremental products (which may involve additional data collection or compilation) at incremental (avoidable) cost
- commercial products.

ANZLIC - The Spatial Information Council

Economic Assessment of Spatial Data Pricing and Access

Stage 2 report: Cost Benefit Analysis of Alternative Models

November 2010

Contents

1 Executive summary

Background

Fundamental spatial data constitute data about the location and attributes of features that are on, above or beneath the surface of the earth, that are captured from primary sources and, typically, cannot be derived from other data. While there are differences between jurisdictions in the delineation of what constitutes fundamental data, examples of fundamental data include topographic information, aerial photography, the cadastre and administrative boundaries.

Fundamental data have historically been produced and maintained by government agencies as part of the core activities of the agencies. Typically, one agency within each jurisdiction has assumed a role as an aggregator of fundamental data from the source agencies. The land information agency typically processes that data to a 'fit for purpose' state and acts as a 'shop front' for sale and distribution to other government and private sector users. A central element of the sale and distribution role is determining and implementing policies on the prices that the agency charges to government and private purchasers of fundamental data.

Governments in Australia and New Zealand have no common or shared view on how they should price fundamental data, or the terms under which they should make fundamental data available to users. ANZLIC – the Spatial Information Council has recognised a potential benefit in having a robust framework for managing access to, and pricing of, fundamental data to support the development and sustainability of the spatial data industry. ANZLIC accordingly commissioned this study by PwC to undertake an economic assessment of alternative models of access and pricing for fundamental data.

Objective of this study

PwC undertook this study in two stages. In Stage One, PwC developed guiding principles for access to, and pricing of fundamental data and defined four alternative pricing models. Stage Two, which is the subject of this report, comprised a comparative analysis of the economic benefits and costs of the alternative models (defined below).

Pricing and access policy has the potential to produce different economic outcomes, depending on the type of approach adopted. The analysis undertaken in this study built on previous economic studies of spatial data pricing and access in the following ways.

- The analysis explicitly addressed the dynamic effects of pricing models – addressing factors such as changes over time in funding for the producer agency and implications for data quality (accuracy, currency, and resolution). PwC used a dynamic modelling approach to evaluate the economic implications of changes in funding, changes in data quality and consequent changes in benefits to society from data use (measured as the economic concepts of consumer and producer surplus).
- An assessment was made of the capacity of alternative pricing models to address the public good characteristics of spatial data, the effect of pricing signals on consumption and production decisions (including the efficient level of investment in data quality) and the dynamics of competition and innovation.

The models

Different pricing models vary in the extent and manner in which users of fundamental data are charged prices to recover costs of production and distribution of the fundamental data.

PwC identified four models for managing the pricing of fundamental data for assessment. These lie on a spectrum of approaches that are differentiated by the extent to which costs are recovered, and by the extent to which there are differences in prices charged to commercial and non-commercial users of data.

At one end of the spectrum of models is the '**full cost recovery model**' in which data are priced to recover all of the costs (the 'full cost') of producing, maintaining and distributing fundamental data from users. The data are licensed such that each new data user is required to purchase the data product from the land information agency at a price that enables the agency to recover the full cost of the data when all data purchases are taken into account. Prices apply uniformly to commercial and non-commercial users.

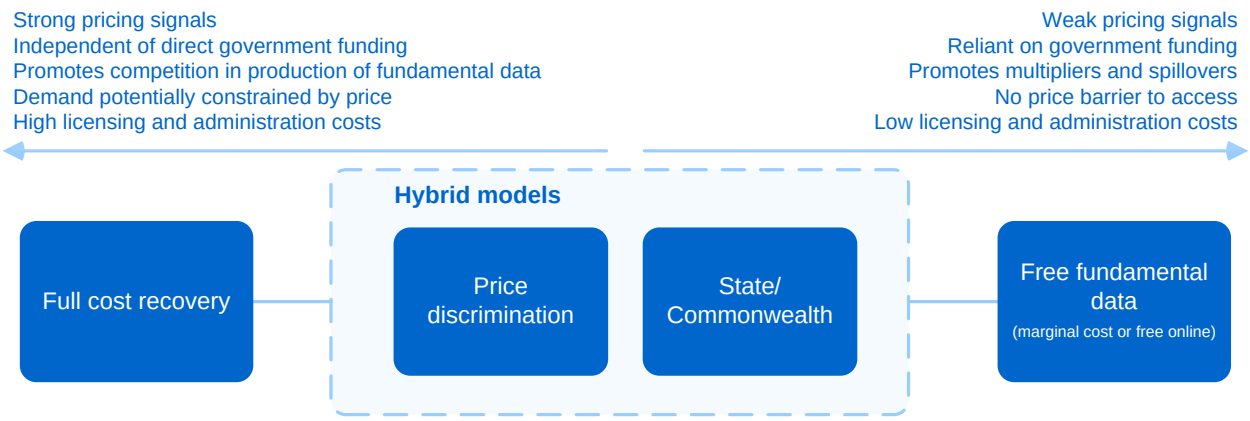
At the other end of the spectrum lies the '**free fundamental data model**' in which fundamental data are priced to recover only the marginal cost of distribution. For electronic distribution of data, such as through internet channels, the marginal cost of distribution is so low as to be effectively zero, and hence the data are made available to users for free. Under this model, governments finance all of the costs of data production, maintenance, extraction and distribution.

In between these two models is the '**price discrimination model**', which applies differential pricing according to customer type. Commercial users are supplied with data at a price based on recovery of full cost, while non-commercial users, including other government agencies, are provided with data at the marginal cost of distribution or for free. Under this model, revenues from commercial users and from government funds finance the costs of data production.

The '**Commonwealth/State model**' is a hybrid of the above models. This model involves the Commonwealth Government providing fundamental data under a free fundamental data model, and state governments providing data under the full cost recovery model.

The alternative pricing models have different consequences for the economics of data production and consumption, which are indicated in Figure 1.

Figure 1: Pricing and access models identified for analysis



Assessment methods

Economic benefits derive from the production and use of fundamental data. The four pricing models were compared on the basis of the changes in the economic benefits that would occur in changing from one pricing model to another such as, for example, changing from the free fundamental data model to the full cost recovery model, or vice versa.

We undertook the comparative analysis in four stages:

- a static welfare analysis to estimate quantitatively the benefits accruing to the producers and consumers of spatial data under each model;
- a dynamic welfare analysis to estimate quantitatively the change in benefits accruing to producers and consumers of spatial data over time due to changes in funding or quality;
- qualitative consideration of a number of other factors including competition and innovation in production of spatial data, data quality, public good values, positive spillovers from use of fundamental data, equity in data availability and pricing, complexity of pricing models, and access to raw data (fundamental data are typically processed to a 'fit for user' state before sale); and
- application of the welfare analysis to four State and Commonwealth fundamental data products.

We evaluated three of the four models quantitatively. The exception is the State/Commonwealth model, which, being a hybrid of the cost recovery and free fundamental data models, is assessed based on the findings of the other models.

Static welfare analysis

A standard modelling technique for measuring costs and benefits is used – referred to as 'welfare analysis'. This technique estimates the net benefits (or economic surplus) accruing to consumers and producers of fundamental data. This is an important measure as it represents the economic efficiency of a particular pricing approach.

We measure consumer surplus by the difference between what consumers are willing to pay and what they do pay. We estimate surpluses for two main classes of consumer – private consumers and government consumers. Producer surplus is the 'profit' earned by a producer (typically a land information agency), estimated by the difference between the revenue generated on spatial data sales and the cost of producing and distributing the data. We sum the consumer and producer surpluses to produce an estimate of the change in welfare from adopting one model over another.

We used a number of input variables in the welfare analysis, and each has a particular effect on the estimated consumer and producer surpluses (Table 1). We obtained values for the variables from both the economic literature and from data provided to PwC from several land information agencies, including Landgate (Western Australia), the Department of Sustainability and Environment (Victoria) and Geoscience Australia (Commonwealth).

Table 1: Variables used in the welfare analysis

Variable	Why important
Proportion of fixed relative to total costs	A higher proportion of fixed costs relative to total costs increases the size of the deadweight loss under the full cost recovery model
Cost of public funds	A higher cost of public funds increases the loss from government funding the fixed costs under a marginal cost pricing model
Government share of consumption	A larger government share of consumption reduces the need to raise public funds to cover the fixed costs under marginal cost pricing model. It also increases the share of benefits accrued by government from elimination of the deadweight loss.
Elasticity (change in demand in response to price)	The deadweight loss under the full cost recovery model is higher where demand is more elastic
Multiplier	A larger multiplier increases the size of the deadweight loss arising from the full cost recovery model

Dynamic analysis

The welfare analysis described above is made between the economic surpluses generated under each pricing and access model in a steady state, at one point in time. It does not take account of the costs and benefits that may accrue over time after a changeover from one model to another.

To produce an assessment that considered the costs and benefits over time, we use a dynamic modelling approach (over a period of 10 to 20 years) to evaluate the economic implications of changes in funding, changes in data quality and consequent changes in consumer and producer surplus. We undertake this analysis by making assumptions about the possible shifts in demand and supply. The interaction between the shifts in the demand curves over time will affect the total level of welfare that the model delivers.

For example, if under the free fundamental data model central government did not maintain existing levels of funding to a land information agency, this would reduce expenditure on fundamental data production. We expect the reduction in expenditure to reduce the quality of the fundamental data. In that case, the demand curve would move down, as purchasers would not be willing to pay the same price for a lower quality product. If this occurs, there is potential for welfare loss as reduced quality reduces the welfare of both marginal consumers and consumers who would purchase at a cost recovery price. This reduction in welfare is magnified if there is a multiplier effect from the use of fundamental data.

We consider the effect of the choice of quality by the agency in a similar manner.

Qualitative assessment

We assess a number of other factors qualitatively, owing to the difficulty of incorporating these factors into the quantitative welfare analysis. These include:

- Competition: Competition is a driver of the efficiency with which fundamental data are produced. Lower cost production will increase the net welfare under any of the

pricing models. A pricing and access scheme that facilitates competition in downstream markets will increase productive efficiency in those markets.

- Innovation: Competition is a driver of innovation. Competition can create incentives for innovation in the production of fundamental data products. Innovation can improve welfare through the creation of new products and new uses for the products.
- Choice of quality: how do the price signals under the pricing and access model facilitate the production of the fundamental data product to the appropriate quality?

The qualitative assessment also reviewed the models under each of the principles that PwC developed in Stage One. These include:

- Public good characteristics: does the model price appropriately for fundamental data products that have public good characteristics?
- Positive spillovers: does the model facilitate the realisation of positive spillovers?
- Equity: is the model horizontally equitable (those who benefit pay) or vertically equitable (those with the greatest capacity pay)?
- Complexity: Does the pricing and access model increase or decrease administrative complexity?
- Access to raw data: Does the model facilitate access to raw data and what are the implications of accessibility of raw data under the model?

Australian application

For each comparison between models, PwC calculated the change in welfare for consumers and producers for a sample of products from Australian land information agencies. These are aerial and topographic data from Landgate and topographic data from the Department of Sustainability and Environment (Victoria) and Geoscience Australia.

Summary of findings

The economic analysis undertaken for this study and set out in the Stage Two report demonstrates that the pricing model with greatest economic benefit varies with differences in the broader economic and policy context for production and consumption of fundamental data.

If adequate government funding can be relied upon, the free fundamental data model delivers greater economic benefits than the alternative models. The larger benefits result from increases in the use of fundamental data that would occur because of the agency providing data free or at a very low price, and flow-on effects of increases in competition and innovation in downstream markets for products and services that use fundamental data. However, the achievement of these benefits also requires that certain other conditions hold, notably that:

- the government agencies that produce the data do not rely on the purchasing decisions of data users to provide signals to guide decisions on the quality of the data; and
- the benefits of free provision of fundamental data are not negated by fewer market opportunities for competition and innovation by non-government producers of fundamental data.

Where these conditions do not hold, the benefits of the free fundamental data model may not be sustained and models that allow for cost recovery are superior in the longer term. The comparative analyses of the current study show that the full cost recovery model is superior where the free fundamental data model results in deterioration in the quality of fundamental data over time due to funding constraints or misspecification of data quality.

The comparative analyses also show that the price discrimination model achieves most of the economic benefit of the free fundamental data model, particularly where there is a significant government share of data use. The price discrimination model provides a trade off between the independent-funding benefits of the full cost recovery model and greater-use benefits of the free fundamental data model.

The price discrimination model has benefits of:

- a high level of use of fundamental data in policy and administrative processes of government agencies;
- a funding stream for fundamental data production and distribution that is at least partly independent of government funds; and
- decisions of data producing agencies on data quality being guided by market signals from purchases of commercial users of data at full cost recovery prices.

Table 2 shows that the finding that the free fundamental model is preferred in the short term is robust, but that the longer-term costs and benefits of each pricing and access model are likely to vary on an agency-by-agency (or product-by-product) basis.

Table 2: Variables and factors underpinning preferred model

Variable or factor	Requirement for free fundamental data model to produce higher welfare than full cost recovery	Is this requirement likely to be met?
Short term (static case)		
Elasticity	Where marginal cost is zero, elasticity higher than 0.5 is sufficient. For marginal cost forming 25% of total cost, elasticity greater than 0.66 is sufficient. A lower elasticity is sufficient if there is a multiplier effect.	Yes. Modern data suggests the elasticity of spatial data are above one.
Marginal cost of production	For elasticity of above 0.66, any marginal cost of less than 25% of total costs result in free fundamental data model delivering higher welfare.	Yes. Marginal cost effectively zero for electronic dissemination.
Multiplier	If the elasticity and marginal cost conditions are satisfied, no multiplier effect is required. Multipliers above one will increase the free fundamental data model benefits.	Yes
Government share of consumption	If the above conditions hold, the free fundamental data model is preferred regardless of government share. As the government share increases, the free fundamental data model benefit increases.	Yes
Public goods and positive spillovers	Where the fundamental data product is a public good (which implies a marginal cost of zero), or there are significant positive spillovers, the free fundamental data model is preferred.	Yes

Variable or factor	Requirement for free fundamental data model to produce higher welfare than full cost recovery	Is this requirement likely to be met?
Long term		
Maintenance of funding / quality	Data quality needs to be maintained at a level such that the economic benefits obtained under the free fundamental data model are not dissipated.	Will vary on an agency-by-agency basis.
Price signals	In the absence of price signals, alternative means of determining the appropriate quality of the data product are required.	Unclear. No evidence of misspecification of quality for products under free data policies examined in this report, but non-price methods have greater misspecification risk.
Competition and innovation	The benefits from competition and innovation in downstream markets need to outweigh deterioration in competition in markets for fundamental data.	Yes. However, if the natural monopoly characteristics of fundamental data production reduce, the balance may change.

Table 3 shows the net change in welfare for modelled scenarios for four Australia fundamental datasets. While the shift along the spectrum from cost recovery to free fundamental data is generally welfare enhancing, deterioration in data quality over time may reduce the net benefits to a level below that which would have occurred had a cost recovery model been in place. The analysis also shows that most of the benefit of a shift from the cost recovery to the free fundamental data model is captured in a shift to a price discrimination model, particularly where there is a significant government share.

Table 3: Summary of welfare effects of changes from one model to another ($m)

	DSE topographic data	Landgate topographic data	Landgate aerial photography	Geoscience Australia topographic data
Cost recovery to free fundamental data	$3.3	$1.4	$1.0	$4.7
Cost recovery to free fundamental data (after 10 years)	-$1.5	-$0.4	-$0.6	-$2.3
Cost recovery to price discrimination	$2.5	$1.3	$0.6	$3.3
Price discrimination to free fundamental data	$0.8	$0.06	$0.4	$1.3

For a change between models in the opposite direction to that indicated in the table, the welfare change is equivalent but of the opposite sign.

These welfare estimates are indicative as opposed to precise welfare effects of a change. They are heavily dependent on parameter assumptions and the form of the model used. Further, from the cost and revenue data provided by the land information agencies, there is some evidence that full cost recovery may not be possible for the data products examined due to insufficient demand. In such a case, the welfare under all of the pricing and access models would be lower than would be otherwise considered the case.

Delivery of objectives by model

Governments and land information agencies may have a range of policy objectives and priorities that will affect the optimal choice of pricing model for fundamental data. Differences in objectives may cause different pricing models to be optimal for different jurisdictions.

Table 4 indicates how different policy objectives and priorities affect the optimal choice of pricing model. The number of ticks in each cell of the table indicates how well a pricing model performs against the objective, with three ticks indicating the best performance.

Differences in government objectives may be reason for variance between jurisdictions in the optimal pricing model. Jurisdictions may adopt the Commonwealth / State model on this basis.

Table 4: Delivery of objectives by model

Objective	Full cost recovery	Price discrimination	Free fundamental data
Economic development	✓✓ Less benefit than alternative models in short term, but may be superior in long term due to access to revenues as a funding stream for data production	✓✓ Less support to economic development than the free fundamental data model but the gap is small where the share of use by non-commercial user is large	✓✓✓ Maximises the use of fundamental data and the contribution and spillover benefits of fundamental data. Benefit may decline in long term if government funding for data production is not maintained
Use of fundamental data by government agencies	✓✓ Government agencies have to pay for use of fundamental data and hence are motivated to reduce use	✓✓✓ Government agencies receive fundamental data for free or minimal price and hence are motivate to maximise use	✓✓✓ Government agencies receive fundamental data for free or minimal price and hence are motivate to maximise use
Generation of government revenue	✓✓✓ Maximises revenue generation and makes data production independent of direct appropriations of government funding	✓✓ There is some reduction in government revenue where non-commercial users use fundamental data.	No revenue generated

Objective	Full cost recovery	Price discrimination	Free fundamental data
Accountability of data producers to funders of data production	✓✓✓ The requirement of land information agencies to derive revenues from data sales makes these agencies responsive to the needs of data users	✓✓ Land information agencies may be responsive to the needs of commercial users of data, but less responsive to government and non-commercial users	✓ As land information agencies do not rely on revenues from data sales, there is no commercial motivation to be responsive to the needs of data users
Availability of data to the community to inform public participation in public policy and government decision making	✓ Public, non-commercial use of fundamental data may be restricted by limited capacity to pay prices.	✓✓ Fundamental data are freely available to non-commercial users	✓✓✓ Fundamental data freely available to all commercial and non-commercial users
Promotion of competition in production of fundamental data	✓✓✓ Competition in production of fundamental data is promoted as private firms may compete on a competitively neutral basis with government land information agencies	✓✓ Free provision of fundamental data to government agencies and non-commercial users limits the market opportunities for private data production firms	✓ Free provision of fundamental data from government land information agencies lessens commercial opportunities for private data production firms
Promotion of competition in downstream markets for services and products using fundamental data	✓ Less use of fundamental data reduces the opportunities for competition in products and services	✓ Less use of data by commercial users reduces the opportunities for competition in products and services	✓✓✓ Free provision of fundamental data promotes competition in products and services

Note: the tick scores indicated in this table indicate relative performance against policy objectives and are not intended to be interpreted as a quantitative assessment of benefits or to be additive across multiple policy objectives.

2 Introduction

Location (spatial) data are an integral component of most public sector information. Increasingly, electronic data on the physical location of objects and the metric relationships between objects is becoming an important 'enabler' of economic development and better public decision-making.

This report focuses on one class of spatial data, referred to as 'fundamental data' or the 'basic information set'. In this report, fundamental data are defined as:

> An authoritative source of spatial data that is maintained to well defined quality standards and cannot be derived from other data

Fundamental data have historically been produced and maintained by government agencies as part of the core activities of the agencies. Typically, one agency within each jurisdiction has assumed a role as an aggregator of fundamental data from the source agencies. The land information agency typically processes that data to a 'fit for purpose' state and acts as a 'shop front' for sale and distribution to other government and private sector users. A central element of the sale and distribution role is determining and implementing policies on the prices that the agency charges to government and private purchasers of fundamental data.

There is no common or shared view across governments in Australia and New Zealand on how fundamental data should be priced, or the terms under which they should be made available to users. ANZLIC – the Spatial Information Council, has recognised a potential benefit in having a consistent and robust approach across governments to manage access to, and pricing of, fundamental data. ANZLIC accordingly commissioned this study by PwC to undertake an economic assessment of alternative models of access and pricing for fundamental data.

2.1 Study objectives and terms of reference

The primary objective of this project is to develop a principles-based framework for accessing and pricing fundamental data. The full set of economic implications (costs and benefits) of alternative models for pricing/access are to be examined, with reference to the value chain for the production of and access to spatial data. Explicit account is to be taken on the dynamic nature of the costs and benefits due to technological changes, and consequent changes in supply and demand fundamentals.

It is not the intent of this study to recommend a single, preferred model for the whole of Australia and New Zealand. Instead, the role of this report is to present a comparative analysis of the various approaches and to identify how well each performs against alternative policy objectives — for example, efficiency, equity, economic development, revenue generation, innovation and data quality.

PwC has been tasked with undertaking an economic analysis that:

- identifies alternative pricing and access models for the overall spatial data management value chain, encompassing the sustainable collection, management, distribution, use, provision of access and commercialisation of 'fit for purpose', public sector spatial data

- compares the costs and benefits of a marginal cost pricing approach as compared to cost recovery models
- provides some dynamic economic analysis, taking into account longer term implications, that can:
  - elaborate on recent local and international research to appropriately provide and price access to 'fit for purpose' spatial data rather than just focussing on demonstrating the economic value of spatial data or the rationale for providing raw spatial data at marginal cost
  - incorporates all of the complex factors: different classes of users; their willingness to pay; the impact of price signals on market efficiency and the role of differential versus uniform pricing regimes
  - be used by governments to consider the key issues and provide clear access and pricing policy advice
- takes account of the practical realities of Commonwealth-State constitutional, structural and funding arrangements and the emerging needs of the spatial data industry.

2.2 Study approach

PwC has taken a two-stage approach to this study.

Stage one involved a scan of the issues, the establishment of guiding principles for pricing and access and the identification of a range of alternative model 'constructs' that could be applied to pricing fundamental data. PwC previously completed a report detailing the outcomes of stage one.

Stage Two involved an economic cost-benefit analysis of the implications of each of four pricing and access models for fundamental spatial information identified for analysis in stage one. Stage Two is the subject of this report.

This report presents PwC's findings for Stage Two of the study.

2.2.1 Stage one results

Different pricing models vary in the extent and manner in which users of fundamental data are charged prices to recover costs of production and distribution of the fundamental data.

Four models for managing the pricing of fundamental data were identified for assessment. The four models lie on a spectrum of approaches that are differentiated by the extent to which costs are recovered, and the prices charged to commercial and non-commercial users of data (Figure 2).

At one end of the spectrum of models is the '**full cost recovery model**' in which data are priced to recover all of the costs (the "full cost") of producing, maintaining and distributing fundamental data from users. The data are licensed such that each new data user is required to purchase the data product from the land information agency at a price that enables the agency to recover the full cost of the data when all data purchases are

taken into account. Prices would apply uniformly to commercial and non-commercial users.

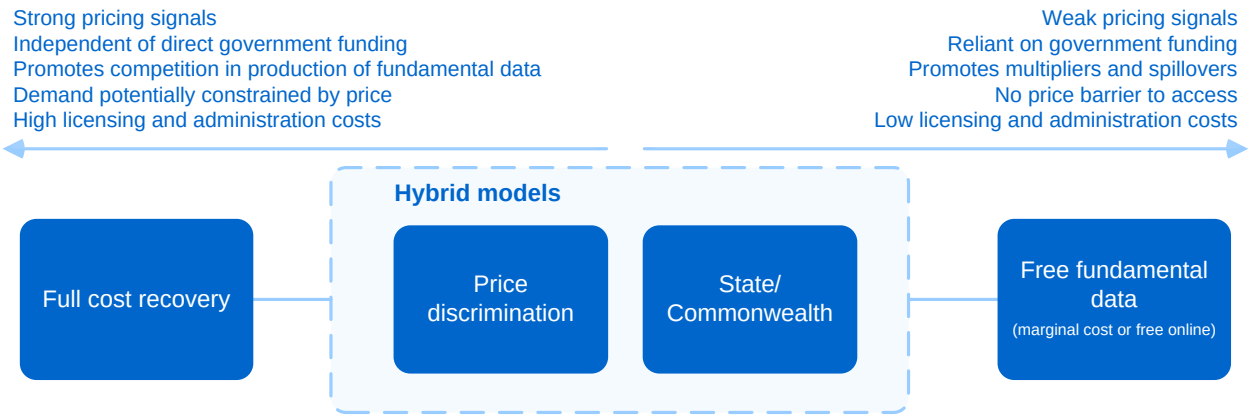
At the other end of the spectrum lies the '**free fundamental data model**' in which fundamental data are priced to recover only the marginal cost of distribution. For electronic distribution of data, such as through internet channels, the marginal cost of distribution is so low as to be effectively zero, and hence the data are made available to users for free. Under this model, all of the costs of data production are financed by governments.

In between these two models is the '**price discrimination model**', which applies differential pricing according to customer type. Commercial users are supplied with data at a price based on recovery of full cost, while non-commercial users, including other government agencies, are provided with data at the marginal cost of distribution or for free. Under this model, the costs of data production are financed by revenues from commercial users and from government funds.

The '**Commonwealth/State model**' is a hybrid of the above models. This model involves the Australian Commonwealth Government providing fundamental data under a free fundamental data model, and State Governments providing data under the full cost recovery model.

The alternative pricing models have different consequences for the economics of data production and consumption, which are also indicated in Figure 2.

Figure 2: Pricing and access models identified for analysis



2.2.2 Stage Two report

Stage Two involved an economic assessment of the benefits and costs of each of the above pricing and access models. Steps taken in Stage Two and detailed in this report included:

- a literature review of previous economic assessments of pricing and access policies for spatial data
- determination of how different cost components associated with the capture, maintenance and distribution of spatial information would be factored into the alternative pricing models

- dynamic cost-benefit analysis of the models by examining, through the use of case studies involving Australian land information agency data products, the nature and magnitude of the costs and benefits associated with one model relative to another. The costs and benefits of the following policy changes were analysed both quantitatively and qualitatively:
  - from full cost recovery to marginal cost pricing (or free online)
  - from full cost recovery to price discrimination (commercial versus non-commercial)
  - from price discrimination to marginal cost pricing (or free online)
- analysis of a Commonwealth / State model whereby cost recovery is applied at the State level and marginal cost pricing at the Commonwealth
- analysis of practical considerations related to the pricing and access models.

2.3 Organisation of this report

The report is structured as follows:

Chapter 3 sets out the methods used for the study. First, the chapter sets out the economic theory that underpins the cost-benefit analysis undertaken in this report. It includes a description of the major economic variables that underpin the analysis and the techniques by which we measure costs and benefits. Second, chapter 3 describes how we apply these techniques to the four pricing and access models selected for examination.

In Chapter 4, we review five previous examinations documented in the literature, each of which evaluate the costs and benefits of various pricing policies for public sector information. The assumptions made and methodology used in each report are summarised and critiqued.

In Chapter 5, we quantify the variables used in the cost benefit analysis. This involves an examination of previous estimates used in the literature for some of the variables and the development of new estimates based on data collected for this report.

Chapter 6 contains the cost-benefit analysis of each of the models selected for analysis. For each model, we compare the relative economic costs and benefits of one model compared to another. A number of case studies are used to illustrate the scale of the costs and benefits. Where there are considerations that cannot be included in the model in a quantitative manner, we examine qualitatively the expected direction of impacts.

Chapter 7 sets out how different policy objectives and priorities affect the optimal choice of pricing model.

3 Methods

This chapter describes the methods that PwC uses for the cost-benefit analysis.

First, we explain the theoretical background to the assessment techniques. This background provides a basis for examining previous assessments of pricing models for spatial information and some elements of the framework used in this study to analyse the four models.

Second, we provide details on how we applied the cost-benefit analysis in this study. The cost benefit analysis comprises three components:

- a quantitative economic analysis, under which the static economic gain or loss from adopting one model over another is determined
- consideration of dynamics that may affect costs and benefits over time
- a qualitative analysis of other relevant factors.

Welfare analysis is a primary tool utilised for quantitative cost-benefit analysis. Economic welfare is defined as the net benefit generated to society from the production and consumption of a good or service. In the context of spatial data, it is a measure of benefits accruing along the value chain, net of costs. However, welfare analysis as described below does not allow full consideration of the public good characteristics of the spatial data and has limited capacity to deal with changes in quality, the effect of pricing signals or the dynamics of competition and innovation. To capture these other impacts, PwC conducts supplementary analysis of the dynamics and qualitative analysis of other factors in this report.

We have applied cost-benefit analysis such that an assessment is made of each pricing model against the pricing and access principles identified in stage one. Those principles were:

- there should be no hard constraints to access (i.e. non-price barriers)
- pricing should promote efficiency
- pricing should be adjusted for public goods and positive spillovers
- pricing should facilitate equity
- pricing should be consistent with competition principles
- pricing and access should be determined on a product-by-product basis.

The cost-benefit analysis performed in this study was designed to each of the stage one principles (Table 5):

Table 5: Summary of methods to assess model performance under pricing principles

Principle	Method	Explanation
Efficiency	Welfare analysis	Welfare analysis provides a static measure of efficiency
	Dynamic considerations	Deterioration in quality over time due to funding or signalling issues can reduce efficiency
	Qualitative analysis	Obstacles to competition and innovation can reduce efficiency Complexity can reduce efficiency and increase administrative costs
Public good characteristics	Welfare analysis Qualitative analysis	Public good characteristics can be examined in the context of a welfare analysis where the decision is a binary decision of whether to supply data or not Otherwise, public good characteristics are analysed qualitatively
Positive spillovers	Welfare analysis Qualitative analysis	Some positive spillovers can be captured through use of an economic multiplier. However, issues such as facilitating non-commercial use require broader qualitative analysis
Equity	Welfare analysis Qualitative analysis	A welfare analysis estimates changes in net benefits across private and government customers and the land information agency Qualitative analysis is used to consider other parties such as taxpayers
Competition principles	Qualitative analysis	Competition may affect efficiency and total welfare over time
Hard constraints to access	Qualitative analysis	Accessibility (or not) of raw data may have competition effects and affect the price signals received by the agency
Product-by-product basis	No explicit analysis	This element is not examined in detail, but it is noted that any pricing and access policy should be implemented on this basis as the balance between the costs and benefits vary between data products

After examining the models quantitatively, dynamically and qualitatively, we apply the analysis to two types of fundamental data products produced by Australian government agencies. These are:

- fundamental topographic data produced by Landgate, Victoria's Department of Sustainability and Environment (DSE) and Geoscience Australia
- aerial photography produced by Landgate.

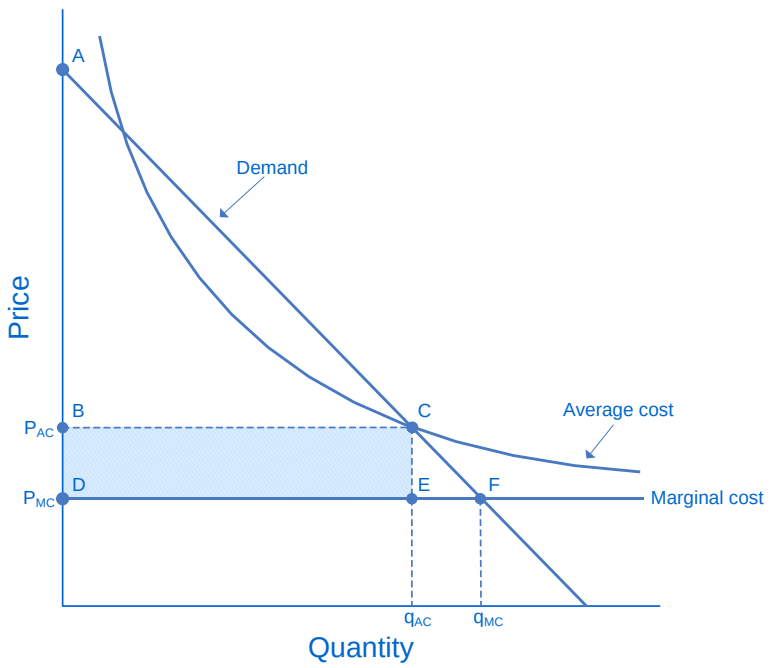
For each dataset, we estimate the costs and benefits of adopting one model relative to another (using a series of pair wise comparisons) and the dynamic implications, and discuss other relevant qualitative issues.

3.1 Quantitative analysis

3.1.1 Welfare analysis

The starting point for welfare analysis is an examination of the demand and supply for fundamental data. We can use a supply-demand relationship to assess welfare changes associated with changes in spatial data pricing policy. This includes situations where the spatial data product is a public good for which there is only a supply, not a quality, decision (quality attributes of spatial data include the current of the data, resolution and coverage). A theoretical representation of the demand and supply relationship for a single spatial information product of fixed quality is shown in Figure 3.

Figure 3: Supply-demand relationship



On the vertical axis is the price of the product and on the horizontal axis is the number of units of the spatial data product that the agency sells (customers purchase).

The demand curve is a downward sloping line, with demand for the spatial data product declining as the price increases. In Figure 3, the demand curve is a straight line, implying a constant absolute change in the quantity demanded for each unit change in price.

The supply curve is the cost curve of the land information agency. Two potential supply curves are shown in Figure 3, each representing different pricing decisions of the supplier. The first is the average cost curve. A supplier would price at the average cost of production if they intended to recover all of their costs (fixed costs plus those that vary with additional units of production). In Figure 3, the average cost declines as the quantity produced increases. The marginal cost curve is the supply curve if the supplier prices at marginal cost (that is, an amount that would just cover the cost of producing an

additional unit of the spatial data product but not fixed costs). Marginal cost should be distinguished from avoidable costs, which are the costs incurred if maintenance, extraction and distribution of a particular spatial data product was ceased.

In Figure 3, the horizontal marginal cost line represents a constant marginal cost regardless of the quantity produced. PwC assumes this to simplify the analysis, although it is also a reasonable assumption for the production and distribution of an information product.

The declining average cost curve and constant marginal cost is representative of production of a good with a specific initial fixed cost, with each additional unit of the good produced for the same cost after that initial outlay. This could represent a fixed cost involving collection and processing of data, with the cost of distribution of each unit of output constant. In this diagram, the fixed cost is equal to shaded area of the rectangle BCDE, which is the difference in the level of cost recovery between pricing at average or marginal cost. Marginal cost pricing does not recover the fixed costs.

Equilibrium between supply and demand occurs where the supply and demand curves intersect. In Different pricing models vary in the extent and manner in which users of fundamental data are charged prices to recover costs of production and distribution of the fundamental data.

Four models for managing the pricing of fundamental data were identified for assessment. The four models lie on a spectrum of approaches that are differentiated by the extent to which costs are recovered, and the prices charged to commercial and non-commercial users of data (Figure 2).

At one end of the spectrum of models is the '**full cost recovery model**' in which data are priced to recover all of the costs (the "full cost") of producing, maintaining and distributing fundamental data from users. The data are licensed such that each new data user is required to purchase the data product from the land information agency at a price that enables the agency to recover the full cost of the data when all data purchases are taken into account. Prices would apply uniformly to commercial and non-commercial users.

At the other end of the spectrum lies the '**free fundamental data model**' in which fundamental data are priced to recover only the marginal cost of distribution. For electronic distribution of data, such as through internet channels, the marginal cost of distribution is so low as to be effectively zero, and hence the data are made available to users for free. Under this model, all of the costs of data production are financed by governments.

In between these two models is the '**price discrimination model**', which applies differential pricing according to customer type. Commercial users are supplied with data at a price based on recovery of full cost, while non-commercial users, including other government agencies, are provided with data at the marginal cost of distribution or for free. Under this model, the costs of data production are financed by revenues from commercial users and from government funds.

The '**Commonwealth/State model**' is a hybrid of the above models. This model involves the Australian Commonwealth Government providing fundamental data under a free fundamental data model, and State Governments providing data under the full cost recovery model.

The alternative pricing models have different consequences for the economics of data production and consumption, which are also indicated in Figure 2.

Figure 2, a land information agency that chose to recover all costs would price where the average cost line intersects with the demand curve (at point C), resulting in a price of p_{AC} and the sale of quantity q_{AC}. Alternatively, pricing at marginal cost would result in the sale of quantity q_{MC}.

Calculating elasticity

Price elasticity of demand is a ratio of the increase (decrease) in demand for a product where there is a decrease (increase) in the price of that product. It is the percentage change in quantity demanded resulting from a one percent change in price. The price elasticity is an important parameter as it effectively determines the shared benefits to consumers and producers from changes in price.

Elasticity is typically determined at a point and represents changes in response to infinitesimally small changes in price. However, the data available concerning changes in the price of spatial (or other public sector) information is typically over large ranges, such as reductions in price from full cost recovery to zero.

In such a case, an average elasticity can be calculated over that range, but the value calculated varies depending upon the method of calculation (Pollock et al, 2008). Use of the high price, low quantity data point as the base of the change will result in the calculation of a higher elasticity (more price responsive) than use of the low price, high quantity data point. In this report, both pairs will be used to calculate lower and upper bound elasticities, utilising the following equations:

Equation 1: Price elasticity of demand using old price-quantity pair

$$\varepsilon_0 = -\frac{\%\,change\,in\,quantity}{\%\,change\,in\,price}$$

$$= -\frac{(q_1 - q_0)/q_0}{(p_1 - p_0)/p_0}$$

Equation 2: Price elasticity of demand using new price-quantity pair

$$\varepsilon_1 = -\frac{(q_1 - q_0)/q_1}{(p_1 - p_0)/p_1}$$

We define elasticity in these equations to be positive.

Where price is reduced to zero, we cannot calculate the lower bound elasticity. In that case, Equation 2 would be undefined.

Calculating consumer and producer surplus

Figure 3 allows the welfare of the land information agency (the producer) and consumers to be analysed. The welfare benefit obtained by the consumer and producer is termed the consumer and producer surplus respectively.

Consumer surplus represents the gap between what the consumer is willing to pay and what they do pay. The customer accrues any difference as a benefit. The area above the price line and below the demand curve represents consumer surplus. In the case of price equalling average cost, the area ABC in Figure 3 is the consumer surplus. Where price equals the marginal cost, the consumer surplus is equal to the larger area ADF.

Producer surplus is the 'profit' earned by the producer. In the case of a cost recovery policy where the price equals the average cost, the producer surplus equals zero. Where price equals marginal cost, the producer surplus is negative, and in Figure 3 is equal to the area BCDE. Area BCDE represents the fixed costs that the producer is unable to recover.

Total social welfare (subject to some considerations noted below) is the sum the consumer and producer surplus. Welfare is maximised where the sum of producer and consumer surplus is maximised.

Deadweight loss

Where a pricing regime results in social welfare being less than the maximum possible, the loss of welfare is called the deadweight loss. In Figure 3, the deadweight loss of a full cost recovery pricing policy is area CEF. **The sum of producer and consumer surplus is maximised when the price is set at marginal cost**.

The intuition of why there is a deadweight loss associated with average cost pricing can be understood as follows. Suppose that price is set at average cost. This means that a group of consumers is willing to pay more than the marginal cost (represented by the demand between points E and F of Figure 3). A sale to these consumers at a price between their willingness to pay and the marginal cost, with the other consumers continuing to pay the average cost price, would leave both the producer and the new consumers better off, and no party worse off. The additional sale has unequivocally improved welfare.

The size of the deadweight loss is larger where there is a high elasticity of demand. If there is high elasticity, consumers are very responsive to changes in price. A shift from average cost pricing to marginal cost pricing with high elasticity of demand will result in a large increase in consumption of the spatial data product. The benefit obtained by these additional consumers represents the deadweight loss that would otherwise be incurred under the average cost pricing policy.

The size of the deadweight loss is also larger, relative to the fixed costs associated with production of the spatial data product, where there are low variable costs (or low marginal cost). Put alternatively, **the larger the share of fixed costs as a proportion of total costs, the larger the size of the deadweight loss relative to the fixed costs**. This is because the difference between the variable costs and total costs is proportional to the difference between the marginal cost and average cost price. A larger relative difference in price increases the size of the deadweight loss.

Equations for the derivation of the deadweight loss are derived in Appendix B.1.

Multiplier

In some circumstances, it may be appropriate to adjust the deadweight loss by a multiplier (λ).

The primary reason for this is that the supply-demand analysis described above is only for direct producers and consumers. It does not incorporate others further down the value chain. If some users of the information are firms which in turn have consumers with their own consumer surplus, the demand curve used in the welfare analysis will underestimate both the initial welfare and the welfare benefits of lower prices.

A second reason is the presence of dynamics and innovation. The demand curve in the welfare analysis is static and does not provide any information on how current prices will affect future demand. Pollock et al (2008) argued that lower prices today might stimulate the rate of innovation of complementary goods or stimulate the development of new goods and services.

A further consideration towards application of a multiplier would be the presence of positive externalities or public good characteristics. If the benefits of consuming spatial data extend beyond the purchaser, the purchaser's willingness to pay will underestimate the social benefit that results from their purchase of the information. A multiplier is one way to try to account for these spillover benefits.

Inefficiencies of raising revenue through tax

The provision of government resources through taxation is inherently inefficient. Costs incurred include collection costs, compliance costs and deadweight loss due to changes in incentives. This inefficiency is termed the marginal cost of public funds. If the marginal cost of public funds were, say, $1.25 for each dollar of taxation revenue raised; this would imply a welfare loss of $0.25 for each dollar of taxation revenue.

In conducting a welfare analysis, the marginal cost of public funds is applied to the level of government funding. For a marginal cost pricing regime with constant marginal cost, the government contribution would be equal to the fixed costs.

As government expenditure on spatial information is small relative to total government revenue, we can take the marginal cost of public funds to be the average cost of public funds for the purposes of the analysis. Therefore, letting 1+β be the marginal cost of public funds and F the fixed costs of production, we can express the deadweight loss resulting from government funding the fixed costs as in Equation 3.

Equation 3: Loss from use of public funds (CPF=cost of public funds)

$$CPF = \beta F$$

We need to adjust this calculation where government is a purchaser of the fundamental data. To the extent that government is a purchaser, a change in pricing regime for government purchasers only transfers funds within government. There is no need to raise additional tax revenue. Letting *g* be the proportion of purchases made by government, we can restate the loss from the use of public funds as in Equation 4.

Equation 4: Loss from use of public funds with government purchasers

$$CPF = (1 - g)\beta F$$

Welfare assessment

Where there is a change in pricing policy, we can use the above elements to construct the change in welfare of the government producers and consumers (ΔGS) and of private

consumers (ΔCS). Summing the change in government consumer and producer surplus and private consumer surplus gives the total change in welfare. The components of welfare for each of these parties can be summarised as follows:

- government land information agencies either recover the fixed costs of production through cost recovery, or pay the fixed costs themselves (using Treasury appropriations)
- government consumers may gain some of the deadweight loss that occurs under a cost recovery pricing regime where pricing moves to marginal cost pricing, plus the portion of the fixed costs they previously paid for when cost recovery was in place
- private consumers can gain the share of fixed costs that they previously paid for plus a share of the deadweight loss if pricing moves from cost recovery to marginal cost.

From the discussion above and as is well established in the literature, we can summarise the effect of a number of the variables on the welfare consequences for each party. These include:

- **high elasticity of demand results in a larger distortion (deadweight loss) for full cost recovery pricing**
- **a high proportion of fixed costs relative to marginal cost increases the distortion from full cost recovery pricing**
- **a large multiplier increases the deadweight loss from full cost recovery pricing**
- **a high cost of government funds increases the cost of marginal cost pricing (the free fundamental data model)**
- **a high government share of consumption mitigates the cost to government from marginal cost pricing and allows government to share in some of the benefits.**

The welfare analysis conducted in chapter 6 examines how these trade-offs play out for each pricing model across a range of parameters and case studies.

3.1.2 Limitations of welfare analysis

Welfare analysis aims to estimate benefits and costs through examination of the supply and demand curves of consumers and producers and using this information to determine changes in consumer and producer welfare. However, it is a simplification of reality and other considerations may add to or detract from consumer or producer surplus. A welfare analysis of the form presented above is subject to a number of limitations.

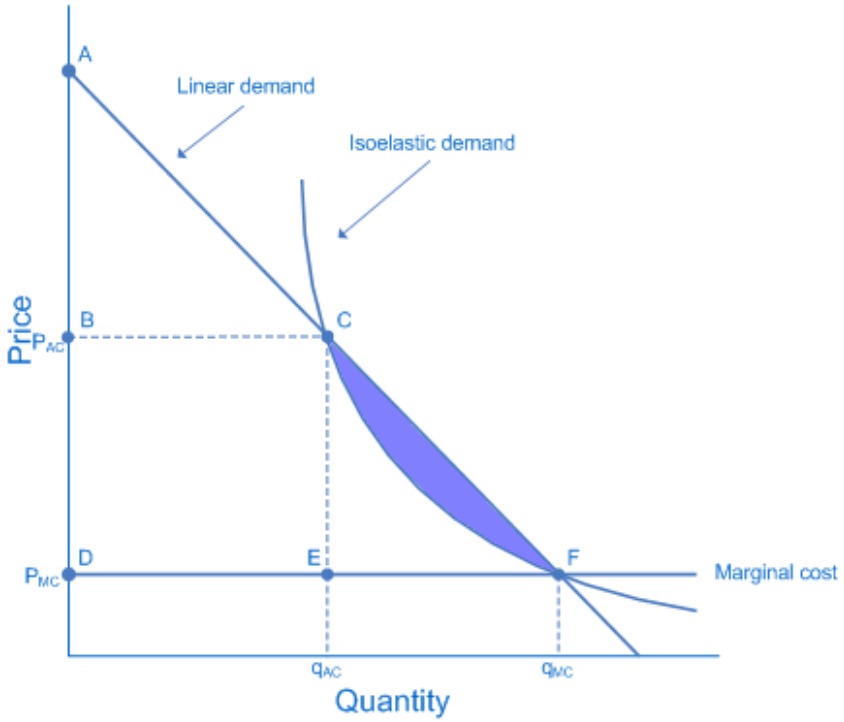
First, it is best suited to evaluating a single product and does not directly deal with changes in quality of that product. We would need to conduct an analysis of each individual spatial data product to determine the welfare effects of adopting alternative pricing policies. For changes in quality, demand curves for each level of quality would be required to allow a comparison of welfare.

The form of the demand curve is critical in determining the outcome of a welfare analysis. The empirical estimates of elasticity and demand curves in this report are generally based on two price/quantity observations, with little evidence on the shape of the demand curve between the observations or as price or quantity approach zero.

A simplification adopted in Figure 3 is a linear demand curve. This leads to constant absolute changes in quantity with each unit change in price. The choice of a linear demand curve implies that the price elasticity of the product, the percentage increase (decrease) in demand for a product for a given percentage decrease (increase) in the price of that product, decreases as price decreases. This is because as price nears zero, a unit change in the price is a larger proportionate change in price but results in the same absolute change in demand.

An alternative assumption of elasticity is constant elasticity. An example of a constant elasticity (isoelastic) demand curve is shown in Figure 4. Compared to the linear demand curve, the constant elasticity demand curve produces larger absolute changes in quantity as price approaches zero. This has implications for the size of the deadweight loss.

Figure 4: Supply-demand relationship with constant elasticity



We have based the two demand curves in Figure 4 on the same two data points (points C and F). The deadweight loss is lower for the constant elasticity demand curve than for the linear demand curve by an amount equal to the shaded area. As is discussed in more detail in section 5.1.1, there are grounds to suggest that an assumption of a linear demand curve has weak support.

A further limitation is that the welfare analysis does not incorporate some other factors that may affect the consumer surplus and deadweight loss, particularly over time. These include changes in quality, the public good characteristics of the product or dynamic factors such as competition and innovation.

Given these limitations, the results of welfare analysis should not be viewed as conclusive. Rather, the welfare analysis serves as an indication of the implications of different pricing and access models, with this being one of a range of relevant factors for an agency to consider.

3.1.3 Application of static welfare analysis

The quantitative assessment will involve a welfare analysis as described above. For each model, the deadweight loss will be calculated and from this, the component government and consumer surpluses that are generated by each model (relative to another base model). We will use these surpluses to determine a total change in welfare. This section describes the variables used in the static welfare analysis and how they enter our calculations.

Variables

The theoretical background above and the reports reviewed in chapter 4 highlight a range of variables that affect the welfare of a cost recovery or marginal cost pricing model. These are summarised in Table 6.

Table 6: Parameters that affect the size of the consumer and producer surplus

Variable	Why important
Proportion of fixed (FC) relative to total costs (TC)	A higher proportion of fixed costs relative to total costs increases the size of the deadweight loss under full cost recovery
Administrative costs	Higher administrative costs will reduce welfare Each pricing model requires decisions around issues such as price, set of data products produced etc., which carries associated costs
Cost of public funds (β)	A higher cost of public funds increases the loss from government funding the fixed costs under a marginal cost pricing model
Government share of consumption (g)	A larger government share of consumption reduces the need to raise public funds to cover the fixed costs under marginal cost pricing model. It also increases the share of benefits accrued by government from elimination of the deadweight loss.
Elasticity (ε)	The deadweight loss under full cost recovery is higher where demand is more elastic
Multiplier (λ)	A larger multiplier increases the size of the deadweight loss arising from full cost recovery
Proportion of purchases by firms	If firms pay tax, a larger proportion of purchases by firms decreases the need to raise additional public funds to fund a marginal cost pricing model
Delay in benefits	If the benefits from changing to a marginal cost pricing model are delayed, a larger delay will reduce the net present value of the benefits of that change

3.2 Dynamic analysis

Changes in welfare between pricing models will also be analysed dynamically (over time) to illustrate the potential effects of a number of considerations that may affect welfare in the longer term. These include:

- **Funding implications: what are the funding implications of the model and what effect does this have on quality and other spatial information characteristics?**

- **Choice of quality: how does the pricing and access model facilitate the choice of the appropriate level of quality?**

- **Competition and innovation: does the pricing and access model facilitate competition and innovation in the production of spatial data products and their use.**

Previous analyses in the literature of the costs and benefits of public sector information pricing policies have typically not been incorporated the first two of these considerations.

3.2.1 Funding implications

We can examine funding implications and changes in quality through shifts in the supply and demand curve. For example, if central government reduced the level of funding provided to a land information agency for the production of spatial data, this would reduce the level of expenditure on spatial data production and result in a downward shift of the average cost curve. We would also expect the reduction in cost to reduce the quality of the spatial data. In that case, the demand curve would also move down, as purchasers would not be willing to pay the same price for a lower quality product.

If quality reduces and the demand curve shifts, the potential for welfare loss is increased, as it is not only the welfare of the marginal consumer that is affected. Reduced quality also reduces the welfare of purchasers who would purchase at a cost recovery price. This reduction in welfare is magnified further if there is a multiplier effect from the use of spatial data.

The interaction between the shifts in the demand curves over time will affect the total level of welfare that the model delivers. In this report, we examine some illustrative examples of this interaction and apply them to the Australian land information agency case studies.

3.2.2 Competition and innovation

Competition is a driver of productive efficiency. While a welfare analysis provides an indication of net benefits based on production and supply of a spatial data product for a certain cost, it is quiet on whether that cost of production is efficient. Lower cost production will increase the net welfare under any of the pricing models. If there is only a single producer of a product, or they are providing the product at a price against which no one else can compete, this will prevent competition from being a driver of productive efficiency.

Competition is also relevant in downstream markets. A pricing and access scheme that facilitates competition in downstream markets will increase productive efficiency in those markets. Broad availability of inputs might facilitate competition in this manner.

Competition is also a driver of innovation. On the one hand, competition might drive productive efficiency by creating incentives for innovation in the production of spatial data products. Further, facilitation of innovation itself can improve welfare through the creation of new products and new uses for the products. The creation of new products

and uses increases welfare by providing goods that provide higher welfare to consumers.

As it is not easy to incorporate competition and innovation into a welfare analysis, we will discuss competition and innovation qualitatively in relation to each of the changes between models.

The availability of raw data products will also have competition and innovation implications. These are discussed separately in section 3.3.6.

3.3 Qualitative analysis

A number of theoretical considerations underpin the qualitative analysis undertaken in this report. This section seeks to explain the basis for these considerations and how we apply them to the models assessed. We then describe how the elements that will be qualitatively analysed in this report.

We noted a number of these qualitative features of the pricing and access models in the Stage One report.

3.3.1 Choice of quality

For many fundamental datasets, land information agencies face a choice as to what quality they should develop the fundamental data. Dimensions of quality requiring consideration include features such as accuracy, currency and resolution.

The choice of cost recovery regime may influence this choice and the ability of the agency to determine the appropriate level of quality.

Suppose that an agency can choose to produce fundamental data at two different levels of quality. Production to a higher quality incurs extra cost. In what circumstances should the agency produce the higher quality data product? If the agency was only interested it its own welfare, it would increase quality until the increase in revenue (the marginal revenue) is equal to the increase in costs. However, this effective exercise of monopoly power is not welfare enhancing for society as a whole.

If the agency was interested in total welfare and currently priced using a cost recovery pricing model, the agency should produce the product to the higher quality if the total consumer surplus increases with the increase in quality and price. However, as is discussed below, this benchmark may result in underproduction where the spatial information has public good characteristics.

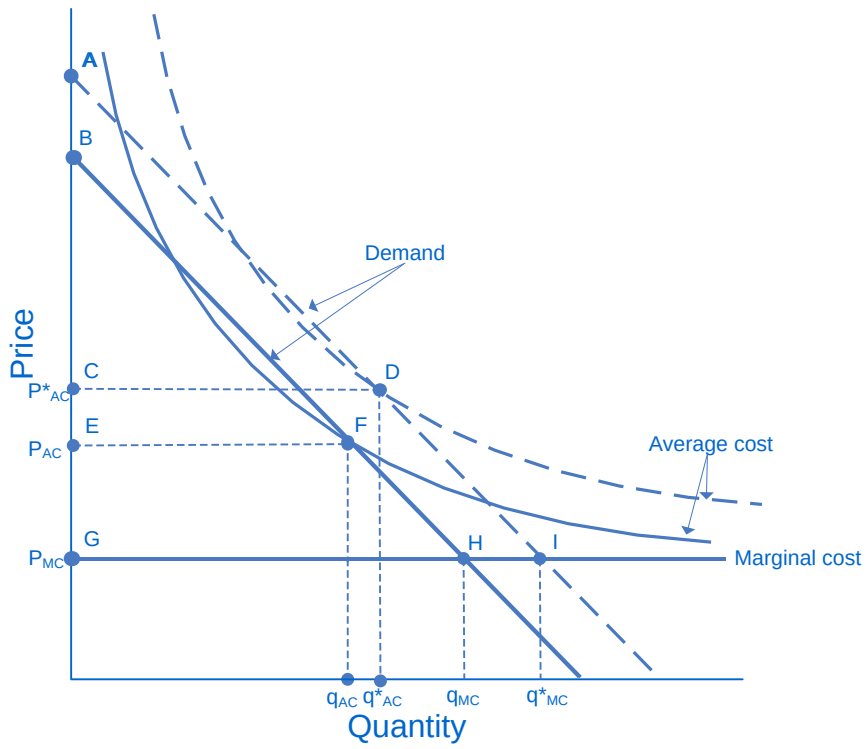
Figure 5 is one diagrammatic representation of the possible implications of a change in quality. In this figure, an increase in quality results in higher fixed costs of production, leading to a higher average cost (the dashed average cost line) but also higher demand for the data product (the dashed demand line).

If price was initially set at average cost (P_{AC}), the increase in quality increases the price paid by consumers (to P^*_{AC}) and the quantity demanded at that price (q^*_{AC}). Although quantity increases in this diagram, whether the quantity consumed at the higher price is greater than that initially would depend on the specific case. The change in welfare also

depends on the specific case and is an empirical question that depends upon the size of the consumer surplus before (area BEF) and after (area ACD) the change in quality.

In this diagram, we assume that marginal cost is constant, reflecting a constant cost of extraction and distribution regardless of quality. If price were set at marginal cost, increased quality leads to increased consumption of the product (to q^*_{MC}). The change in welfare resulting from an increase in quality with marginal cost pricing would depend on the trade-off between the increase in consumer surplus (which is unequivocally positive – from Area BGH to Area AGI) and the cost of public funds associated with increased expenditure by government.

Figure 5: Supply demand relationship with change in quality



We should note that we could draw this diagram in a number of other ways. If the shift in the demand curve was smaller than the shift in the average cost curve, there may no longer be an equilibrium price where cost recovery is possible. Alternatively, if only a small proportion of purchasers desired the data at higher quality, the demand curve may shift in a way that increases its slope or sees the upper portion of the curve shift outwards by a greater amount. In each of these cases, the question of whether production of higher quality data is welfare enhancing would be an empirical question.

Finally, the way in which we drew this diagram implicitly assumes that the original lower quality data are no longer available. If both the low and high quality data were available, the demand curves for each are likely to be more complex, with some customers likely to be satisfied with the lower quality data despite the availability of the higher quality data set. If the lower quality data are not available, this raises competition questions of the type addressed later in this report.

A further problem is that empirically determining shifts in the demand curve in response to data quality changes is difficult, particularly where an agency supplies data at a price equal to marginal cost. In that case, the agency could estimate the demand curve from

requests from customers to produce the data to a higher quality, but this may not be a reliable signal that the agency should increase quality as the requesting party faces a price less than the cost of production. The agency needs other tools to determine if the extra cost would create additional value of a level commensurate with that cost.

3.3.2 Public good characteristics

A good is a public good when its provision to one consumer does not affect its availability and cost to others (non-rival), and after provision to the initial customer, it is then available to all others (non-excludable). Public goods are non-rivalrous, meaning that use of data by one customer does not reduce the amount available to others, and non-excludable, meaning that once the data are available to some, they cannot preclude others from using or re-using it. The Productivity Commission (2001) also suggested that from a public policy perspective, the non-excludability of a good should be assessed from the *desirability* of excluding use.

As a public good is non-excludable, it needs to be provided only once. If the good is purchased or provided, all consumers benefit. The welfare gain from the purchase of a public good by an individual is not just the gain by the purchaser but also includes the amount that the other users gain (i.e. how much each of those individuals would have been willing to pay for the good themselves). This total welfare gain of all consumers is the relevant benchmark for whether government should provide a public good. Further, if a good is non-excludable, there may not be any willing buyers as each seeks to free ride on the purchase of others.

Accordingly, where there is a simple yes or no decision as to whether a public good should be provided, it should be provided where the sum of the willingness to pay of the consumers (the consumer surplus at zero marginal cost) exceeds the cost of provision (adjusted by the cost of government funds). This is equivalent to the welfare analysis, presented in section 3.1.1, where there is zero marginal cost.

There are also cases where the decision to supply a public good is not a binary decision but incorporates various levels of provision of the public good, such as variations in quality. As for the binary case, an agency should base the decision of whether to provide the public good on the benefit accruing to all consumers. To examine how an agency might make the decision, consider provision of the good at its lowest quality. If expenditure of one dollar to increase quality (adjusted for the cost of government funds) resulted in a greater than one dollar increase in welfare across all consumers, quality should be increased until the point that a further increase in expenditure does not result in an equivalent increase in total consumer welfare.

As for quality generally (see section 3.3.1), **we cannot conduct an analysis of the optimal quality of public goods through a simple welfare analysis without confronting significant issues concerning the estimation of demand curves.** As a result, analysis in this report restricted to qualitative discussion.

3.3.3 Positive spillovers

Fundamental data may produce positive spillover effects. Spillover effects (or externalities) are indirect welfare effects on firms or individuals other than producers or consumers of the good. They can be positive or negative.

The use of a multiplier in the welfare analysis may account for some positive spillovers. However, the use of a multiplier is unlikely to capture non-commercial benefits such as

public benefit from better decision-making or improved accountability. Accordingly, we discuss positive spillovers qualitatively.

3.3.4 Equity

The welfare analysis can assist analysis of the equity of a pricing and access model through its identification of the welfare change for the major parties associated with the production and use of spatial data products. This provides a basis for the assessment of some facets of horizontal equity – whether those who benefit pay. However, the analysis is quiet in relation to some parties, such as taxpayers, and it provides a limited perspective on vertical equity – whether those who have the greatest capacity to pay are those who are paying.

3.3.5 Complexity

Complexity can cause a loss in welfare due the resources that must be dedicated to operating in a complex environment. Complex licensing arrangements, for example, can increase administrative costs and transaction costs (for both producers and customers), and create non-price barriers to access.

Data relating to complexity, such as administrative costs, is obtained from a number of case studies of shifts between pricing and access models. We use the observations from these case studies to inform the qualitative discussion of the complexity of each of the pricing and access models.

3.3.6 Hard constraints to access

We conduct the welfare analysis in this report for a particular data product and under the assumption that the product is freely available at the price determined by the pricing model. Where an agency does not allow access to that product at any price, the welfare under any of the pricing models is lost.

From the perspective of the four pricing and access models examined in this report, there are no direct hard constraints to access. However, under various permutations of each model, there is a question as to whether the agency should make ‘raw data’ available. Raw data are defined as the unprocessed data underpinning fundamental data. In some circumstances, land information agencies maintain a monopoly on production of most fundamental data because they do not sell or release the raw data precursors.

This question cannot be examined by simply analysing the welfare of raw data sales and assuming that welfare is lost if it is not available. This is because the sale of the raw data is likely to affect the sale of processed data products and the welfare associated with those sales. Data on the relationship between raw and processed product sales were not available for this report.

Accordingly, for each pricing model, we will qualitatively discuss the implications of allowing access to raw data under each of the four pricing models.

3.3.7 Product-by-product basis

The Stage One report contained a principle that pricing for data products should be set on a product-by-product basis. Different fundamental data products will have differing level of public good characteristics and positive externalities, differing degrees to which different parties capture the benefits and varying levels in which it might contribute to public policy decision making or government accountability. With this variation in attributes between fundamental data products, it is unlikely that a uniform agency level pricing and access policy will be appropriate.

Only one of the models established for assessment in this report was set up to price products on this basis – the free fundamental data model. On that basis, we will not qualitatively discuss the implications of each model under this principle.

4 Previous cost-benefit studies

This chapter reviews five previous reports that have analysed the costs and benefits of different pricing regimes for public sector information. A number of common threads can be drawn from these reports:

- **Marginal cost pricing is preferred where there is high price elasticity of demand (i.e. demand is sensitive to price) and low marginal cost (relative to fixed costs), as in these circumstances average cost pricing (full cost recovery) results in a larger distortion (or deadweight loss).**
- **For tractability of analysis, the demand curve is assumed to be linear.**
- **The assumptions of elasticity and marginal cost vary from one report to the next.**
- **Some assumptions used to underpin the earlier reports may no longer hold.**
- **They generally do not incorporate analysis of quality or dynamics.**

The assumptions underpinning the analysis in each report are highly dependent upon the date of the report and vary depending upon the evidence examined and the method of calculation used. The two studies published prior to the spread of access to fast broadband assume inelastic demand and high marginal cost of dissemination. The methods of calculation of elasticity also vary, with the choice of base for the price change in the earlier reports resulting in lower estimates than could be obtained through using the new price and quantity data point as the base (see section 3.1.1).

4.1 HM Treasury: *The Economics of Government Information*

As part of the 2000 spending review, the United Kingdom's HM Treasury (2000) considered the economics of government information (not specifically spatial data) and the implications of deviating from a price equal to the long run marginal cost. Marginal cost may be higher over the long run as expenditure that is fixed on a day-to-day basis may be varied over a longer period.

The report compared the costs from the distortion (namely, loss in consumer and producer surplus) associated with average cost pricing (full cost recovery) to the distortion arising from government funding under marginal cost pricing, with the marginal social cost of raising public funds was assumed to be around 20-30 per cent of the extra tax receipts. The report's authors theorised that government should provide the subsidy to allow pricing at marginal cost if the distortion associated with full cost recovery is greater than that for providing government funding.

Whether this occurs depended upon the elasticity of demand and the size of the government subsidy relative to total costs. In the case of constant marginal cost, the level of government funding is equal to the fixed costs. A higher elasticity of demand or a higher proportion of government funding (i.e. high fixed costs relative to variable costs) implies that there will be a larger distortion associated with full cost recovery pricing, make marginal cost pricing more attractive. While a higher proportion of fixed costs increase the level of government funding required under marginal cost pricing, high fixed

costs result in a higher average cost relative to the marginal cost, resulting in a larger distortion.

HM Treasury assumed that both elasticity of demand and the size of the fixed costs relative to total costs were low. They considered that the magnitude of scale economies would be less than short run increasing returns, putting long run fixed costs between 10 and 30 per cent of total costs. HM Treasury assumed elasticity of demand was inelastic, as information is an input into production and should be a small proportion of input costs. This was effectively as assumption that the customers were firms. They gave an example where if the price elasticity of a product was two and the information costs 10 per cent of total costs, the derived elasticity of demand for the information products would be 0.2.

Under these assumptions, HM Treasury considered that, in general, the distortions from taxation exceed the distortions associated from pricing at a full cost recovery price, so an agency should seek full cost recovery. HM Treasury noted, however, that in the case of some agencies that raise little revenue from sales, and as a result are already paying the fixed costs, marginal cost pricing will result in little excess tax burden, with little additional burden incurred through additional sales to the public.

Our critique of the findings

The HM Treasury analysis assumes lower elasticity for government information than is assumed in more recent examinations of elasticity, such as Pollock et al (2008) and the results of those made in this report. The low elasticity assumption could be due to the internet being in its infancy. However, HM Treasury does note that if demand were to become much more elastic at low prices, the distortion would only be greater at the bottom of the price range.

The HM Treasury paper also assumes that fixed costs form a smaller proportion of total costs than might be considered the case for most spatial data. The shift to electronic distribution has significantly reduced the marginal costs of production. The estimate that fixed costs are around 10 to 30 per cent of total costs would be well below modern estimates. In the calculations presented in the HM Treasury paper, proportions of 70 per cent to 90 per cent, which might be more accurate today with electronic distribution, result in marginal cost pricing having a lower distortion than full cost recovery for all elasticities above one.

Ultimately, the low estimates of elasticity and fixed costs as a proportion of total costs drive the conclusion that full cost recovery would be welfare enhancing for trading funds.

The analysis also considers only private sector purchases. If a large portion of purchases is by the government sector, as is the case for many spatial information products, a shift to a marginal cost pricing regime has no taxation inefficiency associated with the funding of the government purchases. This is because it has no net budget impact at a whole of government level. This weights the analysis toward cost recovery.

Although public good characteristics are noted, the HM Treasury analysis does not contain any adjustments for public good characteristics or positive spillovers by a multiplier. This naturally has the effect of assuming a multiplier of one.

4.2 Berenschot: *The Wealth Effects of Different Methods of Financing Electronic Databanks*

The Dutch Ministry of the Interior and Kingdom Relations commissioned Berenschot and NEI (2001) to study the effect on wealth of various forms of funding access to electronic databanks. Three of the four databanks examined were engaged in the distribution of spatial information. These were:

- the Large-scale base map of Rotterdam of the Municipality of Rotterdam
- the Current Elevation Model of the Netherlands of the Survey Department of the Directorate General for Public Works and Water Management
- the Top-10 Vector Databank of the Netherlands Topographical Agency.

For these databanks, the wealth effects of changing from the current pricing regime to full cost, marginal cost and zero cost pricing policies were examined, with the wealth effects broken down into the following categories:

- microeconomic effects: changes in consumer surplus, changes in producer surplus and changes in the use of alternatives (substitutes)
- mesoeconomic effects: changes in demand for alternative products, derivative products, competition, quality changes and transparency
- macroeconomic effects: the public sector budget, employment, the democratic process and foreign trade.

In each case, Berenschot found the microeconomic wealth effects of marginal cost pricing to be positive when compared to alternative pricing policies. The effects were generally low, however, as it was determined from survey data that demand among current customers was inelastic. Berenschot also assumed the potential for new customers was low due to the complexity of the data and the technical skills to utilise them.

Berenschot qualitatively assessed the meso and macroeconomic impacts. The potential impact on quality through lower income was noted, as was the potential for increased transparency and democratic participation

Our critique of the findings

The Berenschot study considers many factors that the other cost-benefit analyses of pricing spatial information reviewed in this report did not incorporate. This includes affects on transparency, the quality of the spatial information and facilitation of participation in democracy. However, the difficulty in incorporating these factors into a cost benefits analysis limits analysis to these factors to qualitative review.

The microeconomic wealth effect varies from other reports in this area by not incorporating the efficiency cost of raising government funds. Inclusion of this cost may have changed the balance of the microeconomic wealth effect impacts.

Berenschot based the low elasticity used in the analysis on a survey of existing customers. They assumed there was little potential for new customers. Additionally, and as for the HM Treasury report, the outcomes of this report reflect the time of its release

and pre-date the full spread of high-speed broadband access and the increased accessibility and use of digital products.

The consideration of competition and the ability of the private sector to produce some spatial information products reflected the age of the report. For example, Berenschot considered that were was small likelihood of any competition in production of the elevation model of the Netherlands as private individuals not capable of developing a database of this kind. The entry into the market of firms such as Intermap with this capability has resulted in a more competitive environment than was considered possible at the time.

4.3 Pollock et al: *Models of Public Sector Information Provision via Trading Funds*

The Department for Business, Enterprise and Regulatory Reform and HM Treasury commissioned a report on the pricing of public sector information held by trading funds as part of the Government's response to a report of the Office of Fair Trading into the Commercial Use of Public Information (BERR, 2008). The report by Pollock et al (2008) set out estimates of the costs and benefits of marginal cost pricing.

The approach by Pollock et al was similar to that of the HM Treasury report, although they considered a number of other significant factors. These included:

- consideration of firms as users of spatial information, with these firms returning taxation income to government
- discounting for differences in time between realisation of costs and benefits
- consideration of government as a purchaser of spatial information
- a multiplier effect.

Pollock et al also used a number of recent estimates of the elasticity of demand for information products based on experiences of information agencies moving to zero cost pricing models for online information.

As for HM Treasury, the cost of moving from a full cost recovery to marginal cost model (the payment of fixed costs by government) was compared to the benefits obtained (the transfer of the value of the fixed costs plus elimination of the deadweight loss). To obtain a meaningful comparison, Pollock et al made adjustments for the marginal cost of government funds, the proportion of revenue from government sources, the proportion of producer surplus down the value chain returned to government as tax and the delay in obtaining the benefits.

From this model, the preferred charging regime for different parameter ranges for elasticity (ε) and the multiplier effect (λ) was determined. As is shown in Table 7, for all elasticities above 0.5 (ranging from inelastic to elastic), it was found that marginal cost (MC) pricing is preferred. For elasticities below 0.5 (considered inelastic), the results are mixed. Where we list both, each regime is preferable at different parts of the range, with the pricing method in brackets preferred at the mid-point of the range.

Table 7: Preferred charging regime for different parameter ranges (Pollock et al, 2008)

		λ (multiplier)			
		1	1-2	2-4	4-10
ε (elasticity)	0.0-0.5	AC	AC/MC (AC)	AC/MC (MC)	AC/MC (MC)
	0.5-1.5	MC	MC	MC	MC
	1.5-2.5	MC	MC	MC	MC

While included in the analysis, the tax flow to the government and the time difference between the impact of the benefits and costs had minimal impact on the result.

Pollock et al then applied the model across six United Kingdom trading funds, including Ordnance Survey and HM Land Registry. They also considered a range of products within each trading fund, with the elasticity of demand, multiplier effect and proportion of product supplied to government estimated for each individual product.

With the exception of products from the UK Hydrographic Office, Pollock et al concluded that marginal cost pricing resulted in higher welfare than full cost recovery pricing for all products. This result was robust to reductions of the multiplier to one and the proportion of surplus going to producers to zero. In the case of Ordnance Survey, they estimated that the net benefit to society from a change to marginal pricing was £156 million.

Our critique of the findings

As can be seen in Table 7, the results of Pollock et al's analysis are entirely dependent on the elasticity of demand. If elasticity is lower than 0.5, average cost pricing may be preferred. Otherwise, marginal cost pricing is preferred. This implies that we will have to examine this parameter is some detail in this report.

While the authors have a large number of examples of high price elasticity, the examples relied on as a basis for assuming a high elasticity incorporate a price reduction to zero. As is shown in section 5.1.4 of this report, there is considerable evidence that the elasticity of demand is high where there is a shift to a zero price. This may be due to mental transaction costs, which is the effort involved in deciding whether to purchase or due to the inconvenience associated with payment. Both of these costs will be present even with a very low cost.

This raises two points. First, if elasticity is increasing as price drops and reaches a peak near a price of zero, the use of a linear demand line based on two data points, while resulting in a tractable solution, may result in over or underestimation of the deadweight loss. Second, a demand curve cannot be used to estimate the potentially significant value of uses that would only occur at a price of zero as a welfare analysis assumes that

if someone only purchases at zero price, there is no consumer surplus (or benefit to the consumer) from that purchase.

Pollock et al also assume that the surplus gain from a change to marginal cost pricing accrues solely to private consumers, rather than to government users. This assumption shifts the balance toward cost recovery pricing as government only incurs the cost of public funds where a source of funding external to government is lost.

4.4 Pollock, *The Economics of Public Sector Information*

Pollock (2009) simplified the model presented in Pollock et al (2008) by removing from the analysis tax flow to the government and the time difference between the impact of the benefits and costs. Pollock considered that these factors would likely have a small impact.

Pollock determined the preferred charging regime for different parameter ranges for elasticity (ε) and the multiplier effect (λ). As is shown in Table 8, the results are consistent with those in Pollock et al (2008) despite the omission of variables relating to taxation of firms and delays in benefits.

Table 8: Preferred charging regime for different parameter ranges (Pollock, 2009)

		λ (multiplier)		
		1	1-3	3-9
ε (elasticity)	0.0-0.5	AC	AC/MC (AC)	AC/MC (MC)
	0.5-1.5	MC	MC	MC
	1.5-2.5	MC	MC	MC

Unlike Pollock et al (2008), this report did not seek to examine specific trading funds or products.

Our critique of the findings

The assumptions and implications of this report are similar to those made in Pollock et al (2008). While it may be too simplistic to assume that all consumers have the same price elasticity of demand or that price elasticity does not vary across products, the results from Pollock (2009) and Pollock et al suggest that elasticity tends to be high enough to justify marginal cost pricing across all products. We will examine this assumption in this report as it may provide scope for a price discriminating model.

4.5 ACIL Tasman, *The Value of Spatial Information*

ACIL Tasman's (2009) analysis of the economic impact of spatial information on the Australian economy included consideration of the cost of inefficient access to data and the identification of the factors creating those inefficiencies.

ACIL Tasman noted a number of access issues with current arrangements. These included the lack of simple and effective access, poor quality metadata (information in the data that describes the data) and the lack of a consistent access framework. Costs of these problems included:

- slower development of applications
- less than optimal levels of application and innovation
- less penetration of spatial information into new areas.

For pricing, ACIL Tasman noted that fundamental data are a public good and that charging for cost recovery is inefficient, leading to sub-optimal economic outcomes. They cited the Productivity Commission (2001) report on cost recovery in support of this observation. ACIL Tasman noted that state governments in Australia have not implemented the Productivity Commission recommendations and that they were charging prices higher than marginal cost for fundamental data.

ACIL Tasman did not seek to quantify the economic loss due to the existing pricing policies. However, the authors noted that a more optimal use of fundamental data would have occurred under efficient pricing policies (i.e. policies implemented as per the Productivity Commission recommendations) and that this would have increased productivity and national welfare.

ACIL Tasman sought to make an approximate estimate of the impact of all of the impacts of inefficient access to data including lack of availability, lack of adequacy of spatial data infrastructure and the pricing and access issues noted above. While noting that they could not estimate the constraints on innovation with certainty, ACIL Tasman estimated that the economic impact of the spatial industry in Australia would have been around 7 per cent higher in 2006-07 in the absence of these constraints. ACIL Tasman estimated this by putting the predicted impact on productivity (by sector) through a general equilibrium model.

Our critique of the findings

While the quantitative estimate of the loss from inefficient access to spatial data should be viewed with caution (as ACIL Tasman itself notes), the qualitative observations concerning the impact of the loss is in accordance with the views of stakeholders expressed during consultations for this report.

One element worth highlighting is the observation that public goods should be provided at marginal cost, as was also recommended in the Productivity Commission's report. While not explicitly defining what they consider fundamental data, ACIL Tasman considers that all fundamental data are a public good (non-rivalrous, not desirable to make excludable) and equates to the 'basic information set' identified in the Productivity Commission report. Whether this proposition holds would depend upon a dataset by dataset assessment of the public good characteristics.

5 Data sources

In this chapter, we assign values (or ranges of values) to variables for the quantitative analysis of the different pricing and access models. For some factors that are examined qualitatively, this chapter also examines evidence of the direction and magnitude of their effects.

Sources of data in this chapter include:

- provision by land information agencies and other government agencies that distribute public information
- previous estimates in the literature
- agency annual reports.

5.1 Data for quantitative analysis

5.1.1 Costs

In this section, we use costs for the production, extraction and distribution of data by Landgate (Western Australia), Victoria's Department of Sustainability and Environment (DSE) and Geoscience Australia to obtain parameters for the modelling analysis undertaken in chapter 6. We use a sample of fundamental data products, and in particular, aerial imagery and topographic information products, to derive these parameters.

Western Australia topographic data

The Land Information Authority Regulations 2007 categorises 'land information that consists exclusively of basic topographic information' to be fundamental data. The regulations in turn define basic topographic information as 'land information representing the topography of the surface of the land (including the surface of the natural and the built features of the land)'.

For the production of fundamental topographic data by Landgate, the cost associated with production and maintenance (as opposed to extraction and distribution) incorporates more than 90 per cent of the total costs of providing topographic data products to customers. The production and maintenance costs include a share of agency overheads. The costs incurred for fundamental topographic data in the 2008-09 are shown in Table 9.

Table 9: Western Australia fundamental topographic data production and distribution costs 2008 ($000)

Item	Cost ($000)
Operating costs	929
Capital cost	276
Cost of production and maintenance	1,329
Policy development	70
Production and maintenance subtotal	**2,604**
Topographic extraction database	30
Delivery channel infrastructure costs	239
Extraction and distribution subtotal	**269**
Total	**2,873**

Western Australia aerial photography

The Land Information Authority Regulations states that land information that consists exclusively of aerial photographic images that, among other things, are:

- of the surface of the earth
- have been collected using funding allocated under the State Land Information Capture Program
- are presented in digital form
- have been modified to remove distortions caused by the camera lens, the curvature of the earth and the motion of the aircraft
- have not been modified in any other way.

As for topographic data, the costs associated with this fundamental aerial imagery are predominantly associated with production and maintenance, with this comprising over 90 per cent of the costs (Table 10).

Table 10: Western Australia aerial photography production and distribution costs 2008 ($000)

Item	Cost ($000)
Processing / maintenance	1,194
Database / Application infrastructure	343
Contracts	1,330
Policy development	70
Production and maintenance subtotal	**2,937**
Delivery (labour and shopfront)	190
Extraction and distribution subtotal	**190**
Total	**3,127**

Victorian topographic data

The topographic data products distributed by the Victorian DSE cannot be easily categorised into the fundamental data category used by Landgate, with the DSE distributing topographic data through its range of "Vicmap" products. A large number of Vicmap products including topographic data, including:

- Vicmap 1:50,000 and 1:25,000 scale published maps.
- Vicmap Topographic 1:30,000 Maps Online
- Vicmap Elevation - 1-5 Contours and 10-20 Contours
- Vicmap Hydrography
- Vicmap Vegetation
- Vicmap Features of Interest
- Vicmap Administrative Boundaries (Local Government Areas)
- Vicmap Transport
- Vicmap Property (parcel approved layer).

For the purposes of this costing exercise, we have grouped these products together as *topographic data products*, with Table 11 detailing the costs of production, maintenance, extraction and distribution.

Table 11: Victoria topographic data production and distribution costs 2009-10 ($000)

Item	Cost ($000)
Employees	$670
Spatial information policy setting	$692
Business operations	$1,089
Notification & editing service	$268
Custodial support functions	$637
Application support	$501
Professional services	$276
IT infrastructure & hardware	$866
IT software maintenance/support	$271
Maintenance IT equipment	$9
Map printing	$50
Vicmap product maintenance contracts	$2,615
Production and maintenance subtotal	**$7,945**
Telecommunications network / data infrastructure	$105
Customer engagement	$909
Advertising and publicity	$14
Sponsorships	$6
Extraction and distribution subtotal	**$1,035**
Total	**$8,980**

The DSE was not able to provide a precise split of expenditure between production and maintenance and extraction and distribution. Items such as IT infrastructure are aggregated across both functions. Accordingly, the above split is indicative only.

As is the case in Western Australia, the fixed costs of production and maintenance are the major part of total costs, with extraction and distribution costs representing only 12 per cent of the total.

The overheads costs associated with production of these products are large, particularly in relation to the level of revenue from these products. This is due to the way in which overheads are allocated between Victoria's fundamental data products. The DSE allocated eight percent of overheads to each product, with eight products considered part of the topographic product suite. Accordingly, the DSE allocates 64 per cent of overheads to the products examined in this part. The overheads are shown in Table 12.

Table 12: Victorian overheads in the production of fundamental data 2009-10 ($000)

Item	Cost ($000)
Spatial information management policy setting	$1,039
Departmental expenses	$1,634
Customer Engagement	$1,394
Application support	$752
IT infrastructure	$1,876
Total	**$6,695**

Of these overheads, $4,285,000 is allocated to topographic data products.

Geoscience Australia topographic data

Geoscience Australia produces a range of topographic data and maps. These cover all of Australia and are generally at the 1:250,000 scale, although they also provide some larger scale data on the Australian Capital Territory and smaller scale data products. They also use these data in the production of some hard copy mapping products.

The costs of production, maintenance, extraction and distribution are shown in Table 11.

Table 13: Geoscience Australia topographic data production and distribution costs 2009-10 ($000)

Item	Cost ($000)
Collection, processing and maintenance	$6,279
In-kind contribution (funds)	$659
In kind contribution (imagery)	$2,045
Product creation and support	$1,157
Overheads	$3,572
Production and maintenance subtotal	**$13,290**
Web download cost[1]	$2
Extraction and distribution subtotal	**$2**
Total cost	**$13,292**

[1] Based on 2008-09 web download cost. 2009-10 data not available.

As for the other agencies examined above, the split between production and maintenance and extraction and distribution is approximate. It is not possible to split the share of overheads between extraction and distribution and the production of the data, with items such as ICT service costs likely to be shared across both categories. Overheads comprise staff training and development, human resources support costs, workers compensation, organisational services costs, ICT services costs and property operating expenses.

Geoscience Australia also sells a number of DVD units of maps and data. Geoscience Australia had sales of $74,628 in 2008-09. The above figures also do not include hard copy map sales.

Another important point is that Geoscience Australia, as for other agencies, does not develop data in a vacuum. On the one hand, this is reflected in the in-kind contribution of funds and imagery by other jurisdictions and agencies towards the production of Geoscience Australia's products. Operating in the other direction, the costs incurred by Geoscience Australia in producing topographic data are higher than they would incur if they produced only the data required for their products. Geoscience Australia often collects data at higher resolutions than it requires based on jurisdictional requirements (under the National Topographic Information Coordination Initiative). This has the effect of both increasing Geoscience Australia's costs and reducing those of the agencies that benefit from the initiative.

Proportion of total costs from fixed costs

As was noted in HM Treasury (2001) report, the relative proportion of fixed to total costs is a significant factor in whether an average cost or marginal cost pricing regime preferred.

Where marginal cost is zero, fixed costs equal total costs. This was the basic assumption in Pollock et al (2008) for dissemination of information electronically.

From the Western Australian and Victorian cost data, there is no evidence to move from the assumption of zero marginal cost for online distribution. Geoscience Australia provides a more direct estimate of marginal cost, with the estimate that the cost of web downloads in 2008-09 were $1,842, a cost of $0.01 per MB. This is effectively zero in relation to the $13.3 million in total costs.

To draw out concerns of the land information agencies in relation to the costs associated with extraction and distribution, we will examine marginal costs of between 0 and 25 per cent of the total cost for the general welfare analysis. For specific data product case studies, we will use a marginal cost of zero. If we alternatively assumed that all costs of extraction and distribution are avoidable, we could have a marginal cost of up to 15 per cent of the price. However, this makes would have only minor effects on the quantum of the welfare change is the case studies and would not change the direction of the welfare effect.

Administrative costs

Each of the pricing and access models under consideration carry related administration costs. In the case of a cost recovery pricing regime, there are costs associated with pricing, licensing and customer service. A free online access model avoids some of these costs but may result in other costs such as an increased level of customer contact and the need to use of demand measurement mechanisms as a substitute for pricing.

This section examines some evidence of the scale of these administration costs.

Cost of administering pricing and access regime

Landgate estimated that it engages 1.1 full time equivalent employees in the pricing and 2.1 full time equivalent employees in the licensing of fundamental data products. This staff time costs approximately $250,000. As noted above, the Victorian Department of Sustainability and Environment spends $909,000 on customer engagement under its current pricing model.

Evidence from the scale of administrative savings from agencies that have moved to a free online pricing model indicates that they may be significant relative to the scale of the revenue lost through the change in pricing model.

During consultations, the Australian Bureau of Statistics estimates that it gained efficiencies of approximately $400,000 through the decision to release all online products for no charge. This is over 10 per cent of the lost revenue of $3 million.

The New Zealand National Institute of Water and Atmospheric Research (NIWA) estimated the reduction in administration costs more than covered $NZ120,000 in revenue lost through removing access charges for the National Climate Database.

Statistics New Zealand also identified a number of efficiencies resulting from the decision in 2007 to remove charges for the Streetlink and Digital Boundaries products. These included:

- no need for billing, payment collection or receipting
- ne need for price determination
- no need to deal with resellers
- no need for licensing, such as signing licence documents.

This in turn allowed Statistics New Zealand to reallocate staff within other functional areas. Quantification of these efficiencies was not available, although they were not of a scale to cover fully the lost revenue, with direct government funding making up most of the gap.

These figures are likely to under represent the full scale of administrative costs as they do not capture the administrative costs incurred by the private sector in their dealings with pricing and licensing issues.

Cost of administering free online pricing and access policy

The administrative costs associated with the shift to a free online distribution model might arise through the increased number of customers and the need to identify alternative means to determine levels of demand for information products.

After the Australian Bureau of Statistics removed charges for online products, the total level of contact remained roughly flat, despite the increase in the number of downloads and page views. There has been, however, a shift towards using email as a method of customer contact during the last five years. These trends are shown in Table 14.

Table 14: Number of customer emails and calls completed by the Australian Bureau of Statistics (ABS, 2009)

Year	Emails	Calls	Total
2004-05	12,862	60,820	73,682
2005-06	12,588	56,257	68,845
2006-07	14,278	58,040	72,318
2007-08	15,772	56,739	72,511
2008-09	16,293	50,716	67,009

One method of assessing demand utilised by the ABS are user groups through which the ABS consults with stakeholders concerning its work program. These groups discuss data collection requirements such as question format and data collection techniques. However, these user groups were in place before the change in pricing policy and the ABS does not consider that the number of user groups has changed significantly as a result.

The removal of charges for NIWA's National Climate Database resulted in an increase in inquiries from users. These inquiries included lost passwords (registration is required to access the database), data inquiries and users pointing out errors. However, NIWA considered that the efficiency gains from moving away from charging still outweighed the lost revenue.

Administration cost assumption

Administrative costs were not typically included in previous assessments of land information pricing models. In cases where the report authors explicitly noted them, they generally set them to zero. As the authors considered that administrative costs were higher under the cost recovery model, they saw this as a conservative assumption that weighted the analysis towards cost recovery pricing. It was on this basis that Pollock et al (2008) assumed that the administration costs associated with a pricing and access regime were zero.

This appears to be a sound assumption, with the administrative costs associated with cost recovery appearing to be an order of magnitude larger than those caused by an increased user base. However, in the case of the ABS and NIWA noted above, they removed all charges from the online product as opposed to the release of only selected products, enabling them to avoid fully certain administrative functions.

Accordingly, while we should note administrative cost implications, we will not incorporate them into the quantitative cost benefit analysis.

5.1.2 Revenue and government share of consumption

For fundamental land information in Western Australia, government is the dominant consumer. Between 1 July 2009 and 14 May 2010, Landgate obtained revenue of $1.15 million through the sale of fundamental data. Of this, $1,000,000 was from commercial sources, $3,500 from government and $150,000 for non-government, non-commercial users. However, Landgate provided discounts of $7.95 million for fundamental data products to government users of the information. By value, government is responsible for over 85 per cent of fundamental data consumption. By number of items, the government share is even higher, with Landgate providing 98 per cent to government (115 million of 117 million).

This pattern of use is similar for individual Landgate datasets. The smallest share of government consumption is for aerial photography where commercial consumers purchase $575,000 worth of aerial imagery, non-government non-commercial users consume $45,000 worth and government users consume $1.15 million worth. This puts the government share at around 65 per cent. On a quantity basis, government users consume over 99 per cent (106 million of 107 million). For topographic data, commercial users purchase $158,000 of data, non-government, non-commercial users purchased $27,000 (for $20,000) and government users consumed $2.93 million worth, putting the government share at close to 95 per cent. The government share was similar by number of units supplied.

The above figures exclude royalty payments, such as those that come from provision of data to the PSMA. In the case of royalty payments from the private sector, exclusion of these is appropriate or royalty revenue would artificially inflate the private share of consumption. Royalties from the PSMA, which totalled just over $200,000 in 2008-09, are excluded for a similar reason.

These figures also exclude the proportion of fundamental data production costs covered through the sale of value added products. This is unlikely to distort significantly the result as the fundamental data proportion of the value added revenue is small.

This government share for these datasets must be viewed with caution as government and commercial consumers face different prices and the government share may be significantly smaller if government users also paid a cost recovery based price. However, to approach a level of use equal to that of commercial users (i.e. a government share of 50 per cent) would require government to have a high price elasticity of demand. For example, if government consumption was to halve due to the introduction of cost recovery pricing for their purchases (giving an upper bound elasticity of two), the government share would still be 40 per cent for aerial photography and 90 per cent for topographic data.

For fundamental land information products supplied by Victoria's DSE in 2008-09, DSE received $3.41 million in revenue, with $1.88 million of that revenue from government. In addition to the over 580 digital products sold in 2008-09, over 200 were provided at no charge within government. In addition, the DSE also provides 78 Victorian local councils, catchment management authorities and educational institutions with access to a range of Vicmap products at no charge.

From the revenue figures alone, the government share for the DSE's fundamental data products is approximately 55 per cent. Given the additional products distributed free of charge, the actual government share is likely to be higher. However, we will use the 55 per cent figure for the subsequent analysis, weighting the analysis slightly towards cost recovery pricing.

There is no breakdown between government and private users available for the topographic data or other fundamental data products produced by Geoscience Australia.

These figures are also typical of other jurisdictions. Tasmania's Department of Primary Industries, Parks, Water and Environment receives $18,000 per annum from the sale of spatial information. However, under data sharing agreements with local and state government and the private sector, data to the commercial value of $17.8 million in transferred, of which $5.8 million is to customers external to the department (Table 15).

Table 15: Value of spatial data sharing by Department of Primary Industries, Parks, Water & Environment ($000)

User	Value
Local government and water utilities	$300
State government	$5,300
Intra-departmental	$12,000
Private sector	$200
Total	**$17,800**

No division of revenue between fundamental and non-fundamental data is available for Tasmania.

Queensland's Department of Environment and Resource Management receives around $2 million per annum from the sale of spatial information. Of this, around $280,000 relates to products that would be classified as fundamental under the classification used by Landgate in Western Australia.

Government share of consumption assumption

From the above evidence, PwC will make an assumption of a substantial government share in the analysis in this report. For general analysis, we use a government share of 0.5, which is towards the lower bound of the level of government use. The use of a share near the lower bound will slightly favour cost recovery pricing.

For the welfare analysis of specific data products from Victoria and Western Australia, we should estimate the government share based on both government and private users facing the same price. If government faces no price and private users a cost recovery price, the government share will be inflated. For the cost-benefit analysis, we will assume that government consumption will halve with the introduction of a price. The shares derived by this method are shown in Table 16.

Table 16: Government share of consumption for welfare analysis

Product	Government share
General	0.5
Landgate topographic	0.9
Landgate aerial	0.4
Victoria topographic	0.55
Geoscience Australia	0.5

We will also assume that government is one of beneficiaries of the elimination of the deadweight loss. We have done this to capture improved decision-making and service delivery and cost efficiencies that arise from the improved access to information.

5.1.3 Marginal cost of public funds

One estimate for Australia is that for $1 of tax revenue, the marginal cost is $1.24, meaning that government funding should only be procured where benefits outweigh costs by a factor of 1.24 (Campbell, 1997). HM Treasury (2000) put the marginal cost of public funds in the United Kingdom at around 20 to 30 per cent of the funds raised.

For the welfare analysis in chapter 6 a marginal cost of public funds of 1.25 is used, conservatively weighting the analysis towards a cost recovery model.

5.1.4 Elasticity

Price elasticity of demand is a ratio of the increase (decrease) in demand for a product where there is a decrease (increase) in the price of that product.

Elasticity can be determined though examination of changes in demand in response to price changes. However, as elasticity is typically measured at a point and the available data usually relates to large price changes, there are measurement issues. A range of elasticities can be determined from a single change in price and demand, dependent on the choice of the original or new price and quantity data point as the point from which the elasticity is measured. The use of a single change in price and quantity also provides no evidence as to how elasticity varies along the full length of the demand curve.

Estimates of elasticity in the literature

While HM Treasury (2000) examined a range of possible elasticities in its cost-benefit analysis, it considered that the elasticity was around 0.2 for public sector information.

HM Treasury based this on the assumption that information is an input into production and a small proportion of input costs.

The Office of Fair Trading report on *The Commercial Use of Public Information* (2006) derived a number of estimates of elasticity for public sector information. They used sales and revenue changes that resulted from the introduction of cost recovery for mapping data in New Zealand[2] to derive an elasticity of 0.3. However, Pollock et al (2008) pointed out that 0.3 was a lower bound and that they could derive an upper bound of 2.2.

Similarly, the Office of Fair Trading derived an elasticity of 1.7 from a study in the Netherlands that predicted a 60 per cent price drop for public sector geographic data would lead to 40 per cent annual turnover growth (Bedrijvenplatform, 2000). Pollock et al calculated a lower and upper bound elasticity of 0.48 and 4.17 using those figures.

From the above, the Office of Fair Trading concluded that the elasticity of demand for public sector information is relatively low, with the low, medium and high elasticities for their analysis being set at 0.3, 0.8 and 1.5 respectively.

In addition to the calculations noted above, Pollock et al (2008) examined a number of elasticity estimates from other literature and data from previous pricing changes.

One example examined was the release of material on the ABS website free. Before the June and December 2005 announcements releasing publications and data for no charge on the ABS website, the ABS charged a flag fall for data, with the total cost dependent on the number of cells. The period following the change in policy saw a rapid increase in downloads from the website, as is shown in Table 17 (the drop in 2008-09 reflects the timing of Census releases).

Table 17: Australian Bureau of Statistics – downloads from website

Year	Downloads
2003-04	948,956
2004-05	962,872
2005-06	1,868,280
2006-07	4,501,530
2007-08	7,029,854
2008-09	3,150,630

Using the average dissemination in 2003 to 2005 and 2005 to 2007 as the old and new quantities, Pollock et al estimated an elasticity of 2.33. The quantity of downloads continued to increase after 2006-07, although increased internet usage may have plated some role.

[2] As described in Longhorn and Blakemore (2004)

Pollock at al also determined an elasticity from data obtained under the *Commonwealth Policy on Pricing of Fundamental Spatial Data*. Since the policy's introduction, there has been a rapid increase in the number of datasets obtained, as shown in Table 18. Pollock et al determined an upper bound elasticity of 10.45. As this large increase may be in part attributable to increased availability and use of information technology, Pollock et al also calculated the elasticity by de-trending the data by the level of increase in ABS downloads over that same period (which is before the change in ABS policy) and obtained a revised elasticity of 1.65.

Table 18: Datasets obtained under *Commonwealth Policy on Pricing of Fundamental Spatial Data* (OSDM, 2003 to 2007)

Year	Datasets
2001-02	75,310
2002-03	83,049
2003-04	52,565
2004-05	219,821
2005-06	862,530

Pollock et al also derived elasticity estimated for spatial data products released by Statistics New Zealand for no charge: Streetlink and Digital Editions. However, since Pollock et al made these estimates, further data has become available and we have made new estimates below.

Updated elasticity data

Statistics New Zealand

Before 7 July 2007, Statistics New Zealand charged the prices shown in Table 19 for its Streetlink and Digital Boundaries products.

Table 19: Prices for Statistics New Zealand Streetlink and Digital Boundaries data products

Product	Price
Streetlink	$NZ6,000 plus GST for first supply $NZ2,000 plus GST for annual updates
Digital Boundaries Level One	$NZ25,120 plus GST
Digital Boundaries Level Two	$NZ3,300 plus GST

On 7 July 2007, Statistics New Zealand removed the charges from these products. As is shown in Table 20, this caused a large increase in downloads.

Table 20: Purchases and downloads of Streetlink from Statistics New Zealand (Cosgrove, 2007b, communication with Statistics New Zealand)

Date	Streetlink	Digital Editions
Jul 2006 to Jun 2007	8	47
Jul 2007	75	250
Aug 2007	20	35
Sep 2007	29	16
Oct 2007	25	31
Nov 2007	20	26
Dec 2007	17	220
Jan 2008	26	321
Feb 2008	24	203
Mar 2008	23	236
Apr 2008	28	214
May 2008	28	175
Jun 2008	24	196
Jul 2008	25	158
Aug 2008	23	176
Sep 2008	25	150
Oct 2008	20	131
Nov 2008	26	141
Dec 2008	24	122
Jan 2009	24	199
Feb 2009	21	150
Mar 2009	31	200

Seventy-five downloads of Streetlink occurred in July 2007 compared to 8 downloads in the previous year. A similarly large increase occurred for the Digital Editions products.

Pollock et al (2008) calculated an upper bound elasticity of 34 from the initial increase in Streetlink distribution. As only the July 2007 data was available and it likely represented

a short term upsurge of latent demand (as subsequent data showed was the case), Pollock et al calculated the elasticity on the basis that 75 downloads were made over the *year* following the pricing change. Using a similar approach for Digital Editions, Pollock et al calculated an upper bound elasticity of around six.

With the data through to March 2009 available for this report, we can make an alternative calculation. From August 2007 to July 2008 (omitting the July 2007 outlier), 289 downloads of Streetlink were made. This gives an upper bound elasticity of 35. For the Digital Editions products, allowing a period for demand to settle, 2012 datasets were downloaded between April 2008 and March 2009. This number gives an upper bound elasticity of 42.

Government and private sector elasticity

One element of elasticity for which there is little evidence is whether government and the private sector have different elasticities of demand for different products. To obtain this data would require evidence arising from changes to price discrimination policies and from price discrimination to a marginal cost model.

Variation in elasticity

With a linear demand curve, a certain absolute price changes results in a constant absolute change in quantity, resulting in the elasticity of demand decreasing towards zero as the price nears zero. The above evidence does not provide strong support for a linear demand curve assumption. The elasticity estimates are highest when an agency reduces the price to zero, suggesting absolute changes in quantity increase as price approaches zero. Given this, a demand curve that is flatter at lower prices, such as a constant elasticity curve, may be a better approximation.

As is noted above, the choice of demand curve may have implications for the calculation of deadweight loss. The evidence addressed above suggests a case for considering alternative demand curve shapes as part of the analysis.

A theoretical consideration

If demand for a good is elastic (i.e. elasticity greater than one), the seller of the good can increase their revenue by decreasing the price. This is because for any decrease in price, quantity will increase by a greater proportion.

Accordingly, if the elasticity estimates above are accurate and there is elastic demand for spatial (or other government) data, the agency could reduce price and increase revenue. This raises the question of why government has not taken this action, or alternatively, why the government is pricing at a level above that required to recover costs.

Possible resolutions to this question include lack of responsiveness by government (as it is a natural monopoly), large changes in demand around a zero price inflating the elasticity estimates or a non-zero marginal cost of production. In the first case, a reduction in price with the maintenance of a cost recovery policy would enhance welfare, while in the second, we need to again consider the consequences of variation in the shape of the demand curve. Finally, if the additional revenue is not sufficient to cover the marginal cost of each additional unit, it would not be optimal to increase price. However,

this final explanation is not reflective of the near zero marginal cost of electronic distribution.

Elasticity values for analysis

Due to the broad range of elasticity estimates and the potential for variation in elasticity as price approaches zero, the cost benefit analysis in this report will test across a range of elasticities. The tested elasticities are 0.3, 0.5, 0.75, 1 and 2. The lowest elasticity of 0.3 matches the lowest of any observed elasticity (although this is above the HM Treasury estimation of 0.2). As was shown in previous cost-benefit analyses, elasticities above two strongly favour marginal cost pricing across all feasible ranges of the other parameters.

We also test these elasticities for linear and constant elasticity demand curves. In the case of the constant elasticity demand curve, only elasticities less than one are considered. For the zero marginal cost case, an elasticity above one results in an infinite deadweight loss for any non-zero price.[3]

Finally, for the case studies relating to specific data products, we will use an elasticity of one. While above the lowest estimates in the literature, an elasticity of one is below modern estimates involving products distributed online. We do not have adequate data to differentiate the elasticities between different data products.

Table 21: Elasticities of demand for welfare analysis

Product	Elasticity
General	0.3, 0.5, 0.75, 1, 2
Landgate topographic	1
Landgate aerial	1
Victoria topographic	1
Geoscience Australia	1

5.1.5 Multiplier

There is little empirical evidence of the size of the multiplier effect that results from the production and distribution of fundamental data. To determine the size of consumer surplus down the value chain would require detailed demand data at each value chain step. The multiplier impacts of innovation and dynamics would require detailed time series data at an industry level. Data of this nature is not available.

Pollock et al (2008) reviewed some examples that indicated the multiplier might be significant. This included the dynamism of the United States weather data sector

[3] This occurs as any price reduction results in a proportionally larger increase in quantity, which in turn increases revenue. This could be repeated continuously, generating unbounded revenue gains.

compared to Europe, the economic impact of the release of Ordnance Survey data and evidence of the benefits of information in other sectors. However, given the varied and anecdotal nature of the evidence, Pollock et al examined a range of multipliers from one to 10.

We consider multiplier values of 1, 1.5, 2 and 3 in this report. For multipliers above three, the multiplier drives the result (in a similar manner to high elasticities) and marginal cost pricing is always favoured.

We have undertaken the analysis of specific datasets from Australian land information agencies with the assumption of a multiplier of one, which favours a cost recovery model.

5.1.6 Purchases by firms

Pollock et al (2008) included in their analysis the impact of tax paid by firms that are consumers of spatial data (see section 4.3). The analysis in this report does not incorporate this element, as we do not have relevant data of use further down the value chain. This will favour cost recovery in the welfare analysis as increased consumption by private sector firms under a marginal cost model as inclusion of this element would result in a flow of tax to the government, partially offsetting the government funding of the fixed costs of spatial data production. However, as was established in Pollock (2009), it is a relatively minor impact that will not significantly change the results (see section 4.4).

5.1.7 Delay in benefits

Pollock et al (2008) incorporated a delay between achieving the benefits changing pricing regime and obtaining the benefits from elimination of the deadweight loss. They adopted a delay of a year and a half based on delays in the increase in usage after changes in pricing regime (see section 4.3).

Given the short timeframe involved, the discount due to the delay has a small effect on the preferred pricing model and accordingly, Pollock (2009) excluded the delay in benefits from the analysis. We take the same approach in this report, slightly weighting the result towards marginal cost pricing.

5.2 Data for qualitative analysis

5.2.1 Quality

An agency can produce spatial data at varying levels of quality. Examples of variations in quality might be the frequency with which they update the data, the resolution of the data or the area of coverage. An agency could take aerial photography at varying levels of detail while topographic data can be at differing scales. Variations in quality have cost implications and are likely to result in shifts in both the supply and demand of spatial data.

Quality may vary due to decisions by the agency (based on signals from customers) or through limitations on the funding available for the production of spatial data. In this section, PwC examines evidence for changes in quality under different pricing and

access regimes to provide a basis for examination of change in quality for the cost-benefit analysis.

There are a number of possible proxies for the quality of spatial data. These proxies include the product range, data accuracy and timeliness. In addition, the level of funding provided for development and maintenance of data may provide an indication.

These proxies as to quality may arise either due to explicit choices made by the agency or due to funding implications that arise through the pricing and access model under which the agency makes the data available.

Australian Bureau of Statistics

While a quantity measure, the number of products released free online is effectively a quality measure due to the increased information coverage provided by the ABS. There has been a large increase in the number of spreadsheets released each year by the ABS since the shift to a policy of releasing all online products for no cost. There was increase from 705 spreadsheets in 2004-05 to 10,000 in 2008-09. There has also been a small increase in the number of publications over this period, as seen in Table 22.

Table 22: Datacubes, time series spreadsheets and publications released by year (ABS, 2009)

Year	Datacubes & spreadsheets	Publications
2004-05	705	733
2005-06	5,373	781
2006-07	7,546	711
2007-08	8,773	818
2008-09	10,000	805

As indicator of accuracy, the ABS reports the rate of revision for the quarterly gross domestic product and current account transactions estimates between the initial release and one year later. There has been no significant change in the level of revision for these products, as shown in Table 23.

Table 23: Revisions to quarterly gross domestic product and current account transactions – difference between first estimate and one year later (ABS, 2009)

Year	Quarterly gross domestic product (% points)	Quarterly current account transactions (%)
1999-00	0.1	2.3
2000-01	0.2	3.4
2001-02	0.2	2.7
2002-03	0.1	1.8
2003-04	0.2	1.2
2004-05	0.1	1.7
2005-06	0.1	1.1
2006-07	0.2	1.6
2007-08	0.2	2.6

Commonwealth fundamental data provision

Since the implementation of the *Commonwealth Policy on Pricing of Fundamental Spatial Data*, expenditure on fundamental data by the Commonwealth was steady between 2002-03 and 2005-06 (Table 24). There was a large decline in expenditure after the first year of operation of the policy is a result of a large expenditure for the National Land and Resources Audit and unusually high expenditure by the Australian Hydrographic Survey on 2001-02. Geoscience Australia, the major Commonwealth provider of fundamental data, slightly increased expenditure between 2001-02 and 2005-06.

Table 24: Annual expenditure on fundamental data ($000) (OSDM, 2007)

Year	Geoscience Australia	Total
2001-02	59,116	102,327
2002-03	60,600	78,297
2003-04	63,556	88,232
2004-05	62,148	86,100
2005-06	67,565	85,741

The Office of Spatial Data Management has not collected any agency expenditure data since the 2005-06 financial year.

Statistics New Zealand

Since the removal of charges for access to the Streetlink and Digital Boundaries products, there has been no change in the frequency of updates to these products or the level of coverage.

New Zealand National Institute of Water and Atmospheric Research

While there are no substantive measures of quality for the National Climate Database, the increased level of contact from customers under the no charging policy has included the identification of errors in the data. This has some potential to drive an improvement in quality.

6 Model Analysis

In this chapter, we compare the full cost recovery, free fundamental data and price discrimination models through a quantitative welfare analysis and a qualitative analysis of factors that an agency should consider in a pricing and access decision. We also perform a qualitative analysis of the Commonwealth / State model in the light of the analysis of the other three models.

Section 6.1 summarises the costs and benefits of shifts between the various pricing models.

Section 6.2 analyses the costs and benefits of a shift from a cost recovery to free fundamental data model. We undertake a quantitative analysis of the change in welfare for each party involved in the transaction, with consideration of dynamics, and a qualitative assessment of factors not incorporated into the quantitative welfare analysis. The section closes with an analysis of welfare changes utilising for a sample of products from Australian land information agencies. While the pricing policies currently applied to the Australian land information agency products vary, as does the level of costs recovered, each is analysed from the perspective of this policy change to enable comparability of results.

Sections 6.3 and 6.4 contain a similar assessment for a shift from the cost recovery to the price discrimination model and a shift from the price discrimination to the free fundamental data model.

Section 6.5 contains a qualitative analysis of the Commonwealth / State model. As this model involves a combination of the models discussed in the previous sections, the focus of the analysis of the Commonwealth / State model is on features of the Commonwealth and States that may shift the weighting of costs and benefits in different directions for each.

6.1 Summary of results

6.1.1 Quantitative analysis

A static welfare analysis of the pricing and access models shows, as was demonstrated in previous reports, that changes in welfare are largely a function of the cost of public funds incurred through funding the production of fundamental data and the deadweight loss that is incurred through a cost recovery pricing model.

Free fundamental data relative to full cost recovery

Except in cases of low elasticity of demand (which is atypical), the free fundamental data model generally delivers the greatest social welfare at a point in time. This is the case even where the lowest possible multiplier of one is applied.

In a dynamic context, the welfare obtained under the free fundamental data model may be eroded if funding is not maintained from central government for production of fundamental data or if there is misspecification of quality. It is possible to develop scenarios where the benefits of the free fundamental data model are dissipated over a

relatively short period, with subsequent years resulting in a reduction in welfare relative to cost recovery.

Price discrimination relative to full cost recovery

A shift from the cost recovery to price discrimination model is always welfare enhancing, although it does involve redistribution of benefits between the land information agency and the rest of government. The redistribution involves the land information agency being required to fund the fixed costs of production itself (from Treasury appropriations). Where there is a large government share of consumption, most of the welfare benefits from the free fundamental data model are captured under the price discrimination model.

If the funding to the land information agency from Treasury appropriations is not maintained, the benefits of the price discrimination model could be dissipated over time.

Free fundamental data relative to price discrimination

The shift from the cost recovery to free fundamental data model is more likely to generate a positive change in welfare than the shift from price discrimination to free fundamental data as the former has government as a beneficiary, which does not have an associated cost of public funds. For the shift from the price discrimination model to free fundamental data, all of the lost revenue carries with it an associated cost of public funds.

We have presented mathematical representations of the changes in welfare in Appendix C.

Application to Australian products

Application of Australian cost and elasticity data finds the net benefit across all producers and consumers of a free fundamental data model compared to full cost recovery for Landgate's topographic and aerial data, Victorian topographic data and Geoscience Australia's topographic data estimated to be approximately $1.4 million, $1.0 million, $3.3 million and $4.7 million respectively. For a shift from a price discrimination model to the free fundamental data model, the benefits are $0.8 million, $0.06 million, $0.4 million and $1.3 million. The benefits are much smaller for the shift from price discrimination to free fundamental data as most of the benefit is obtained in the shift from cost recovery to price discrimination.

For a change between models in the opposite direction to that indicated, the welfare change is equivalent but of the opposite sign.

6.1.2 Qualitative analysis

Table 25 summarises the qualitative costs and benefits of changing between the cost recovery, price discrimination and free fundamental data models.

Table 25: Costs and benefits of changes in pricing and access policy

Impact	Cost recovery to free fundamental data	Cost recovery to price discrimination	Price discrimination to free fundamental data
Choice of quality	Price signals as to value to consumer lost	Price signals as to value to government consumer lost	Price signals as to value from private consumers lost
Public goods and positive spillovers	If fundamental data products have public good characteristics, allows benefits to be realised Maximises positive spillovers	If fundamental data products have public good characteristics, allows benefits to be realised in non-commercial sphere Allows realisation of positive spillovers arising from increased use by government and other non-commercial users	If fundamental data products have public good characteristics, allows benefits to be fully realised May increase positive spillovers from commercial use
Equity	Equitable if public good characteristics or positive externalities leading to large class of beneficiaries	Issue of equitable distinction between commercial and non-commercial use	Promotes equity between users but may be inequitable to taxpayers if beneficiaries a narrow group
Complexity	Reduction in pricing complexity Possible issues with selection of free data	Potential complexity around identification of non-commercial use Possible issues with selection of free data for non-commercial use	Reduces pricing complexity (i.e. licensing, billing, administration and user differentiation)
Raw data accessibility	Under cost recovery model, making raw data available will increase competition in processing and improve better signal as to quality. If raw data accessible under free fundamental data model, unlikely to be any competition in processing as fundamental data also available for free.	Under cost recovery model, making raw data available will increase competition in processing and improve better signal as to quality. Under price discrimination model, if high government share, accessibility of raw data may not increase competition as processed product available to major customer.	Under price discrimination model, if high government share, accessibility of raw data may not increase competition as processed product available to major customer. If raw data accessible under free fundamental data model, unlikely to be any competition in processing as fundamental data also available for free

For the Commonwealth / State model, the costs and benefits listed in Table 25 apply within each jurisdiction according to the model applied.

6.2 Comparison of full cost recovery and free fundamental data models

This section reviews the costs and benefits of moving from a cost recovery model to free fundamental data. Under the free fundamental data model, all users gain access to fundamental data at marginal cost (free online).

6.2.1 Static welfare analysis

When an agency shifts from the full cost recovery to free fundamental data model, the land information agency has a decrease in welfare equivalent to the level of fixed costs that they are now required to fund themselves (Equation 5). Government consumers gain, however, with government agencies that use the data no longer having to pay the purchase price, and some additional government use occurring at the marginal cost price (Equation 6).

Equation 5: Change in land information agency surplus from change to free fundamental data model from cost recovery

$$\Delta LIAS = -F$$

Equation 6: Change in government consumer surplus from change to free fundamental data model from cost recovery

$$\Delta GCS = gDWL + gF$$

Accordingly, the gain by government from this change in pricing policy is equivalent to government's share of the previously foregone deadweight loss, while it loses the proportion of fixed costs that the private sector previously funded.

The gain by the private sector is equal to those fixed costs that the private sector is no longer required to cover and the private sectors share of the deadweight loss. This change, weighted by the cost of public funds, is shown in Equation 7.

Equation 7: Change in private consumer surplus from change to free fundamental data model from cost recovery

$$\Delta CS = \frac{(1-g)(F+DWL)}{1+\beta}$$

When summed, this gives a total change in welfare that is positive where the gain through the removal of the deadweight loss (weighted for the share gained by government) is greater than the loss incurred by the requirement that government cover some fixed costs that were previously funded by the private sector (Equation 8 and Equation 9).

Equation 8: Total change in welfare from change to free fundamental data model from cost recovery

$$\Delta W = \Delta LIAS + \Delta GCS + \Delta CS$$

$$= gDWL - (1-g)F + \frac{(1-g)(F+DWL)}{1+\beta}$$

Equation 9: Conditions for positive change in welfare from change to free fundamental data model from price discrimination [4]

$$(1+\beta g)DWL > (1-g)\beta F$$

Whether the total change in welfare is positive depends on the level of fixed costs, the size of the deadweight loss, the government share and the cost of government funds.

Linear demand curve

With an assumption of a linear demand curve, the deadweight loss can be calculated, giving the following condition for whether a change from cost recovery to free fundamental data is welfare enhancing (Equation 10).

Equation 10: Conditions for positive change in welfare with a linear demand curve

$$(1+\beta g)\frac{1}{2}\varepsilon\frac{F^2}{TC} > (1-g)\beta F$$

If we adopt the conservative assumption that the share of government purchases is zero (favouring average cost pricing), the marginal cost of public funds is 0.25 and marginal cost equal zero (equivalent to free online, some feasible combinations of the multiplier and elasticity give the results in Table 26. In this and the subsequent tables, MC indicates that marginal cost pricing is preferred, while AC indicates higher welfare for full cost recovery. MC/AC indicates that the welfare from either policy is the same.

Table 26: Linear demand curve: preferred pricing model

	Multiplier (λ)				
Elasticity (ε)		1	1.5	2	3
	0.3	AC	AC	MC	MC
	0.5	MC/AC	MC	MC	MC
	0.75	MC	MC	MC	MC
	1.0	MC	MC	MC	MC
	2.0	MC	MC	MC	MC

The results shown in Table 26 are effectively the same as the results of Pollock et al, as shown in Table 7 in section 4.3. Once the elasticity is above 0.5, marginal cost pricing is generally preferred. Marginal cost pricing is also preferred at lower elasticities where there is a high multiplier effect.

[4] See Appendix A for the derivation of this equation.

It is also worth considering various mixes of fixed and variable costs (i.e. a non-zero marginal cost). Allowing a multiplier of one but varying the ratio of fixed to total costs, we obtain the results in Table 27.

Table 27: Preferred pricing model: preferred pricing model

	Ratio of fixed costs to total costs (F/TC)				
Elasticity (ε)		0.75	0.9	0.95	1
	0.3	AC	AC	AC	AC
	0.5	AC	AC	AC	AC/MC
	0.75	MC	MC	MC	MC
	1.0	MC	MC	MC	MC
	2.0	MC	MC	MC	MC

Under these conditions, there is a broader range of circumstances where average cost pricing is preferred. For all elasticities of 0.5 or less, average cost pricing is the welfare enhancing option.

Constant elasticity demand curve

If we examine demand functions with constant elasticity, we obtain a similar welfare result to that obtained with the linear demand curve, although with a stronger leaning to favour marginal cost pricing. For the scenario of a government share of zero, zero marginal cost and a cost of government funds of 0.25, we get the result in Table 28.

Table 28: Preferred pricing model – constant elasticity demand curve

	Multiplier (λ)				
Elasticity (ε)		1	1.5	2	3
	0.3	MC	MC	MC	MC
	0.5	MC	MC	MC	MC
	0.75	MC	MC	MC	MC

For the lowest multiplier of one, cost recovery pricing is only preferred for any elasticity less than 0.2 (i.e. very low elasticity). For all other pairs of parameters considered, marginal cost pricing is preferred.

If we examine a range of alternative proportions of fixed costs relative to total costs, for the case of a multiplier of one, average cost pricing is preferred for any elasticity less than 0.2. It is also preferred for an elasticity of 0.3 where fixed costs are 75 per cent or less of total costs (see Table 29).

Table 29: Preferred pricing model – constant elasticity demand curve

	Ratio of fixed costs to total costs (F/TC)			
Elasticity (ε)		0.75	0.9	0.95
	0.3	AC	MC	MC
	0.5	MC	MC	MC
	0.75	MC	MC	MC

Interpretation of results

As is noted in section 5.1.4, most modern estimates of elasticity are above one, with the lowest measured elasticity of any dataset examined in this report, 0.3, being from 10 years ago. It is also likely that fixed costs are the predominant portion of costs, with a near zero marginal cost of production. With those parameters, even with no multiplier effect, marginal cost pricing is generally preferred.

Limitations of analysis

As is noted in section 3.1.2, this welfare comparison is one-dimensional and does not incorporate factors such as public good characteristics, funding and changes in quality. The subsequent sections seek to incorporate these and other factors.

6.2.2 Dynamics

Funding and quality

To incorporate the implications of pricing decisions, such as changes in funding and quality, a dynamic analysis over a number of years is required. While the evidence on the nature of dynamic changes in response to pricing policy is ambiguous, we can explore plausible scenarios for changes in quality or funding. However, given the nature of the assumptions made, the examples below are illustrative only.

A change from the cost recovery to free fundamental data model results in a significant change in the funding base for the land information agency, with production of fundamental data dependent upon public funding. If government does not fully replace the revenue lost by a land information agency in the shift to a free fundamental data model, the level of expenditure by the agency will decline. This will affect the quality and availability of fundamental data products.

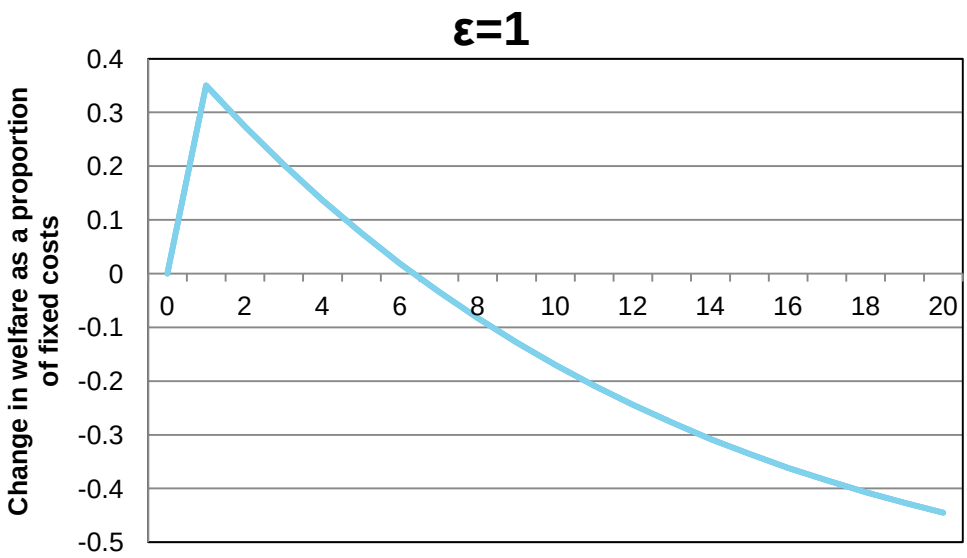
The move from the cost recovery model to marginal cost pricing also removes price signals as to quality. The land information agency is required to rely on other demand signals such as communication with customers, which may be less reliable as there is no requirement for the customer to pay the full value of what they request. This could result in an agency supplying a product of too high or low quality.

As an illustration of the funding and quality issues, suppose that after a shift from a cost recovery to free fundamental data model, the agency reduces expenditure by 3 per cent (real) each year. This might represent difficulty in obtaining funding for production of the

fundamental data, or a misspecification of the appropriate level of quality in the absence of a pricing signal. If this decline in quality results in a corresponding 3 per cent decline in demand (represented by the demand curve moving left by 3 per cent each year), the initial welfare gain from the move to the free fundamental data model is eroded over time. This erosion occurs as the consumer surplus decreases at a faster rate than the savings from lower government expenditure on fundamental data production and maintenance. This erosion of surplus includes consumers who would purchase at prices at or above average cost.

A graph of what this scenario might look like over a 20 year period is shown in Figure 6. This particular scenario utilises a government share of consumption of 50 per cent, a marginal cost of public funds of 0.25, a multiplier of one, a marginal cost of zero and an elasticity of one. The scale on the left hand side is representative of the change in welfare as a proportion of fixed costs.

Figure 6: Change in total annual welfare as a proportion of fixed costs over 20 year period: ε=1

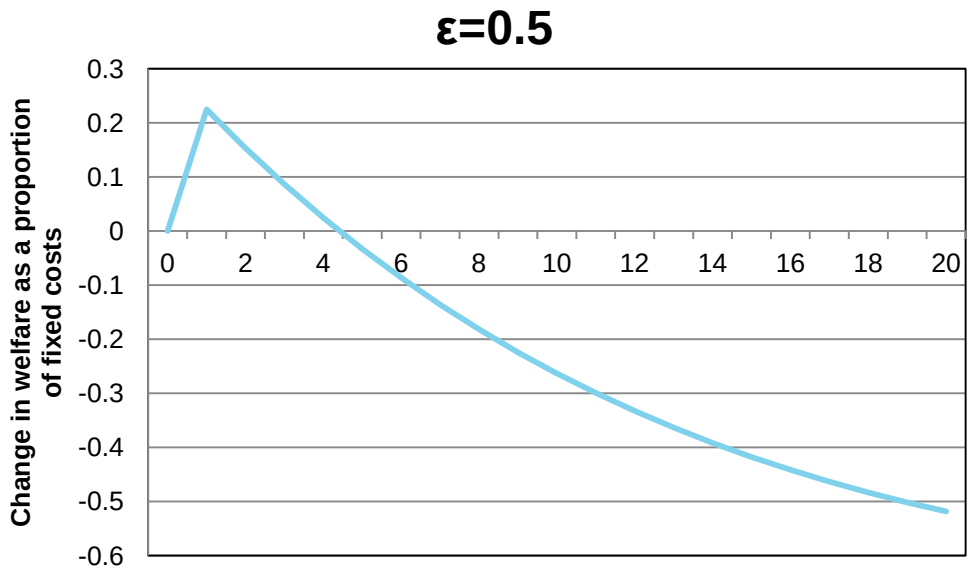


This example shows an initial increase in welfare in the first year of the free fundamental data policy followed by a gradual decline in welfare as the quality of the data product deteriorates. From year eight, welfare is below that attained under a cost recovery policy.

This illustration is dependent upon a number of assumptions. These include a reduction in demand commensurate with the reduction in expenditure and the absence of substitutes (such as a private sector party commencing supply of the product at a higher quality).

As for the welfare analysis generally, this illustration is heavily dependent on parameters such as the elasticity of demand. For example, where elasticity is lower, the initial increase in welfare is lower and followed by a decline that leads to a negative impact on consumer welfare by year 5, as shown in Figure 7.

Figure 7: Change in total annual welfare as a proportion of fixed costs over 20-year period: ε=0.5



Competition and innovation

The natural monopoly characteristics of the production of fundamental data do not foster competition, although there are some data that do not fit this mould. A decision to provide fundamental data for marginal cost will destroy any potential for competition in the production of the fundamental data products. Unless a private sector party develops a significantly different business model, they will be unable to compete at a price of zero.

The absence of competition will potentially reduce cost efficiencies and innovation in the production of these products. Cost efficiencies increase the welfare of government through reducing expenditure and increase the welfare of taxpayers by reducing the need to raise government funds. In a dynamic sense, this absence of competition could erode the initial welfare gain under a free fundamental data model.

However, the free fundamental data model might positively affect competition in downstream use of the data and in the production of value added products. By supplying the data to the largest possible group, the free fundamental data model provides a low (no) cost platform for innovation, with the absence cost allowing experimentation with the fundamental data products. As was the case with the introduction of Google Maps, the products and services that may arise are unlikely to be foreseeable before the fact and may result in significant benefit.

6.2.3 Qualitative analysis

This section qualitatively analyses issues concerning public good characteristics, positive spillovers, equity and hard constraints to access for the shift from cost recovery to the free fundamental data model.

Choice of quality

The cost recovery model facilitates choice of quality to the extent that the agency will receive a signal whether the total willingness to pay of customers is sufficient to cover the cost of any extra quality the agency chooses to add to the data. However, this does not ensure that the agency chooses the efficient level of quality. The addition of extra quality to a data product may be of no value the customers, but as they need the underlying data, they are willing to pay for the data regardless. The cost expended in adding the extra quality is a deadweight loss.

One safeguard against this in the cost recovery model is that those customers who do not require the extra quality have an incentive to inform the agency of their desired level of processing so that they can avoid paying for excess quality. The agency can take this as a reliable signal and use this information to determine whether the additional expenditure on quality is welfare enhancing.

More serious problems are faced with the free fundamental data model, as there is not even the safeguard that the total willingness to pay of the customers will be sufficient to recover costs. The agency must be guided in its quality decisions by information gathered under previous pricing policies, unreliable customer demands and other information gathering methods such as surveys.

Public good characteristics and positive spillovers

Each fundamental data product considered in this report could have public good characteristics. They are non-rival as they are information products, with excludability dependent upon the nature of the licence. As discussed above, an agency should consider the desirability of excludability to assess whether a product is a public good.

The welfare analysis above would suffice for a decision whether to provide or not provide a specific fundamental data product as a public good. Where there is a positive change in welfare from a shift to the free fundamental data model, provision of the public good will increase welfare. However, the welfare analysis is of less use in assessing the level of provision (i.e. quality) of the public good. As noted in section 3.3.1, information on the sum of the marginal rate of substitution of consumers is required (i.e. the change in their willingness to pay based on a change in quality).

An agency should conduct a dataset by dataset analysis of whether each is a public good to determine the breadth of any free fundamental data model.

The shift to the free fundamental data model allows for full realisation of any positive spillovers from the fundamental data, whether derived from commercial or non-commercial uses. Government decision-making and service delivery can make full use of the data and benefits from other non-commercial users can be realised without any pricing barriers to access.

Equity

Under the cost recovery model, direct users pay. Given they are willing to pay the purchase price, they also benefit to a level greater than the cost of production of the data.

However, if there are significant positive externalities from their purchase of this data or they are not able to exclude other consumers from accessing the data, there might be a

broader set of beneficiaries. In such circumstances, a broader funding base such as taxation may be appropriate.

Neither the cost recovery of free fundamental data policy makes any distinction on ability to pay. As such, neither policy addresses horizontal equity issues.

Complexity

The cost recovery and free fundamental data models each have areas of complexity. There is complexity associated with determining appropriate pricing and access for fundamental data under the cost recovery model, while the free fundamental data model has complexity associated with the assessment of which fundamental data products an agency should release under the free data policy.

Raw data accessibility

On implication of failing to make raw data available under the cost recovery model is that where further processing is not required for some purchasers, those purchasers are effectively subsidising the processing of the data for those users that do want the processed product. This also has the effect of distorting the signals for demand for the processed product. What appears to be demand for a certain degree of processing may be the need to access the underlying data.

To estimate the welfare implications of raw data availability would require information on the demand for raw data. This information is not available for the fundamental data products examined in this report. The United Kingdom Office of Fair Trading (2006) suggested that there was a more elastic demand curve for raw data than for processed products, suggesting that failure to provide raw data could be causing a material decline in consumer surplus. From raw data demand data that it had available, the Office of Fair Trading report quantified those losses.

A further implication of raw data availability under a cost recovery policy is competition in value adding market to produce fundamental data products. This may drive efficiency and innovation, although it creates the potential for duplication to the extent there is a natural monopoly in this area and there is duplication as opposed to customisation.

Under the free fundamental data model, we would only expect the private sector to engage in the processing of raw data where the value added is significantly greater than that added by the land information agency or they are creating discrete customised products. To the extent that there is a market for uniform fundamental data, the free processed product from the land information agency will dominate. In the absence of a radically different pricing model, it is not possible for the private sector to compete against a price of zero.

6.2.4 Australian application

From the cost data for individual jurisdictions (described in Chapter 5), it is possible to give a sense of magnitude to the changes in welfare discussed above. Table 30 shows estimates of welfare changes for a change from cost recovery to marginal cost pricing for Victorian, Landgate and Geoscience Australia topographic data products and the Landgate aerial photography products. These estimates are derived using the equations described in section 6.2.1.

Table 30: Changes in welfare from adopting the free fundamental data model, relative to the cost recovery model

	Victoria's Department of Sustainability and Environment topographic data	Landgate topographic data	Landgate aerial photography	Geoscience Australia topographic data
Total cost	$9.0 million	$2.9 million	$3.1 million	$13.3 million
Marginal cost	0	0	0	0
Elasticity	1	1	1	1
Government share	0.55	0.9	0.4	0.5
Multiplier	1	1	1	1
Δ land information agency surplus	-$9.0 million	-$2.9 million	-$3.1 million	-$13.3 million
Δ government consumer surplus	$7.4 million	$3.9 million	$1.9 million	$10.0 million
Δ total government surplus	-$1.6 million	$1.0 million	-$1.2 million	-$3.3 million
Δ private consumer surplus	$4.9 million	$0.3 million	$2.2 million	$8.0 million
Total Δ in welfare	$3.3 million	$1.4 million	$1.0 million	$4.7 million
Total Δ in welfare in year 10	-$1.5 million	-$0.4 million	-$0.6 million	-$2.3 million

These changes in welfare in Table 30 are indicative only as they rely on a number of assumptions that may hold to varying degrees. First, we used a linear demand curve with an elasticity of one. If the demand curve changes in slope, and in particular, becomes flatter as price approaches zero, the welfare change associated with a shift to a free fundamental data model may be lower.

Second, we have assumed that there is adequate demand to operate a cost recovery policy. Given the gap between current revenue and the scale of revenue required to fully recover costs, this is not a certain proposition. For example, even if government had paid

for its share of Landgate's aerial photography, there still would have been a revenue shortfall of over $1 million. For Landgate's topographic data, Landgate would cover its costs if government paid for its share, although we would expect that the quantity consumed by government would reduce if they were required to pay, leaving a revenue gap. If there is not sufficient demand to recover costs, welfare will be lower than calculated for all of the pricing policies.

Finally, as shown in section 6.2.2, there is potential for a decline in any initial welfare gain as quality declines. Under the scenario of a 3 per cent decline in expenditure and a corresponding 3 per cent decline in demand as quality falls, the potential welfare gains for Western Australian topographic and aerial photography have deteriorated by year 10 of the marginal cost pricing policy to losses of $0.4 million and $0.6 million per annum respectively. The gain in welfare for Victorian topographic data has deteriorated to a $1.5 million reduction in welfare after 10 years, while the loss of welfare is $2.3 million for Geoscience Australia's topographic data after that period. As for the general analysis of funding deterioration above, these figures are illustrative only.

Given these limitations, however, we can make some interesting observations. The change in total welfare at the time of the pricing change is larger where there is a larger share of government use. In this case, the improvement in welfare for Western Australian topographic data, which has a larger share of government users, is greater than that for aerial photography. This is because there is a reduced need for funding from taxation where government users are the beneficiaries.

The welfare change experienced by government is also more positive with a larger government share, with the change in welfare positive across government in the case of Western Australia topographic data. This pricing move for Landgate's topographic data is revenue positive across all of government, although the impact to Landgate is negative. For a smaller government share, such as for Landgate's aerial photography, the government experiences a negative change in welfare, despite the positive total welfare change.

6.3 Comparison of full cost recovery with price discrimination

This section reviews the costs and benefits of moving from a cost recovery model to price discrimination. A shift to the price discrimination model from full cost recovery sees government and other non-commercial users gain access to fundamental data at marginal cost (free online), with commercial users continuing to pay the cost recovery price.

As is shown below, the conditions for this change are in some cases stronger than the shift to the free fundamental data model as the policy maintains revenue flows from the private sector and there is no need to increase overall government funding.

6.3.1 Static welfare analysis

Under the price discrimination model, the land information agency no longer receives payments from other government agencies or non-commercial users towards the fixed costs of production. The land information agency is consequently worse off by this sum (Equation 11). However, the welfare of the government agency customers, who are no

longer required to pay the purchase price, increases by the size of the fixed costs they no longer pay. These agencies also gain a share of the deadweight loss lost under the previous policy because of the shift to marginal cost (Equation 12).

Equation 11: Change in land information agency surplus from change to price discrimination model from cost recovery

$$\Delta LIAS = -gF$$

Equation 12: Change in government consumer surplus from change to price discrimination model from cost recovery

$$\Delta GCS = g(DWL + F)$$

The net result of these changes across the whole of government is a positive welfare change. The change in policy simply shifts payment of fixed costs within government to the land information agency.

This change in government surplus has not incorporated any lost revenue from purchases by non-commercial non-government users. We adopted this simplification as the data provided by the land information agencies indicated a low level of non-government, non-commercial use. This assumption is balanced by not providing to non-government, non-commercial users a share of the deadweight loss eliminated by the change in pricing policy. This leaves the gain in private consumer surplus at zero.

These conditions result in a total change in welfare that is always positive, as shown in Equation 13. The rationale for this is that the land information agency is not required to make up the loss of the payment for fixed costs by through taxation. Rather, there is a reallocation within government. As a result, there is no loss through the cost of public funds.

Equation 13: Total change in welfare from change to price discrimination model from cost recovery

$$\Delta W = \Delta LIAS + \Delta GCS + \Delta CS$$

$$= gDWL$$

Given the change in welfare is effectively dependent upon the elimination of deadweight loss that occurred through under-consumption by government, the benefit from a change to the price discrimination model is larger where elasticity of government demand is high.

6.3.2 Dynamics

Funding and quality

A change to the price discrimination model from full cost recovery has negligible impact on total government funding unless there is a significant level of usage by non-government, non-commercial users (which based on usage information from land information agencies, does not appear to be the case). However, there is an impact on land information agency funding, with the land information agency losing revenue previously received from other government agencies. The size of this reduction is higher as the government share increases. As government has a net gain from the policy

change through elimination of a proportion of the deadweight loss, reallocation within government could make all parties better off.

However, if funding for the land information agency decreased due to a failure to reallocate funding within government or due to budget cuts following an initial reallocation, the dynamic impacts explored for the change to the free fundamental model may be similarly applicable, with the scale of the impact dependent upon the government share of use.

If an agency reduces quality through funding constraints, the shift to price discrimination will affect the private sector more heavily than a shift to a free fundamental data model. This is because the private sector will incur the costs of reduced quality without any of the welfare gains that come from a change in pricing policy.

As for a shift to the fundamental data model, there may also be quality issues in the absence of a pricing signal from government users as to the appropriate level of quality. This is particularly the case where government is the main user. The degree of misspecification arising from the policy is likely to be dependent on substitute means of determining value and the degree to which internal government pricing signals were previously representative of the value of the information. This could lead to erosion in welfare over time.

The government share of use is particularly important in this model, with a higher government share increasing the funding impact on the land information agency and creating a larger class of users from which pricing signals are lost.

Competition and innovation

It is arguable that the price discrimination model is the most deleterious of the pricing models towards competition. It removes the potential for competition in the government market, which for many fundamental data are the major market, while not providing the basis for competition in value added markets that the free fundamental data model can provide.

Therefore, the price discrimination model provides a weakened incentive for cost reductions and innovation compared to that that would occur in a competitive market.

6.3.3 Qualitative analysis

This section qualitatively analyses issues concerning public good characteristics, positive spillovers, equity and hard constraints to access for the shift from cost recovery to the price discrimination model.

Public good characteristics and positive spillovers

A decision to provide non-commercial users with access to fundamental data products may be implicit identification of the public good characteristics of these products within government and for other non-commercial users. However, it lacks the product-by-product assessment of public good characteristics that would identify which datasets are appropriate for such an approach.

Under the price discrimination model, there is no recognition of the benefits that could arise from the use of public goods by private users. Pricing for public good

characteristics should encompass both commercial and non-commercial uses, with the non-rivalry of public goods allowing further distribution for negligible additional cost (although potentially considerable revenue).

The price discrimination policy does provide for maximisation of the positive spillovers from government access to fundamental data, such as fully informed decision-making and the provision of services utilising the information. The price discrimination policy also facilitates spillovers from other non-commercial uses.

Equity

If non-commercial and government uses of fundamental data have larger positive spillovers than commercial users, a price discrimination policy might be more equitable. Price discrimination may also enhance vertical equity if commercial users have more capability to pay.

Complexity

The price discrimination model has significant implications of the pricing and access regime. Under this model there is required to be the development of pricing for commercial users, deciding which products are available to non-commercial users for marginal cost and distinguishing which users are non-commercial. The process of distinguishing non-commercial use may entail considerable complexity, particularly where an agency is required to develop criteria for non-commercial use and assess users against those criteria to determine their eligibility for non-commercial pricing.

Raw data accessibility

The consequences of raw data being available under the cost recovery and price discrimination models are largely similar as under both models commercial users with the capacity and commercial interest in creating products from the raw data face a cost recovery price under either model.

6.3.4 Australian application

A static welfare analysis with a sample of Australian land information agency data shows a positive change in welfare from the change to a price discrimination model from cost recovery (Table 31). As noted above, this is because funding lost by the land information agency is transferred within government, leading to no additional costs from taxation. A larger government share increases the scale of the benefits relative to the costs of production. These estimates are derived using the equations described in section 6.3.1.

Table 31: Changes in welfare from adopting the price discrimination model, relative to the cost recovery model

	Victorian topographic data	Landgate topographic data	Landgate aerial photography	Geoscience Australia topographic data
Total cost	$9.0 million	$2.9 million	$3.1 million	$13.3 million
Marginal cost	0	0	0	0
Elasticity	1	1	1	1
Government share	0.55	0.9	0.4	0.5
Multiplier	1	1	1	1
Δ land information agency surplus	-$5.0 million	-$2.6 million	-$1.2 million	-$6.7 million
Δ government consumer surplus	$7.4 million	$3.9 million	$1.9 million	$10.0 million
Δ total government surplus	$2.5 million	$1.3 million	$0.6 million	$3.3 million
Δ private consumer surplus	$0	$0	$0	$0
Total Δ in welfare	$2.5 million	$1.3 million	$0.6 million	$3.3 million

The cost to the land information agency decreases the lower the government share of consumption. This is due to the land information agency being required to cover a lower level of costs. However, the total gain from the policy change increases with the government share of consumption, with a larger group having the benefit of the marginal cost pricing policy.

Dynamically, the impact of this policy change is larger the greater the government share. The higher this share, the greater the level of revenue lost by the land information agency and the smaller the remaining market from which to receive a price signal. For government users, there is a probability of misspecification of quality in the absence of the price signal, with the potential for welfare decline in circumstances of continuous misspecification.

6.4 Comparison of price discrimination with free fundamental data

This section reviews the costs and benefits of a shift from the price discrimination model to the free fundamental data model. Under this change, the price paid by commercial users is reduced from a cost recovery price to marginal cost. Government and non-commercial users are not affected.

6.4.1 Static welfare analysis

The land information agency loses the portion of fixed costs previously paid for by the private sector (Equation 14). There is no change in government consumer surplus as government consumers are already receiving the fundamental data at marginal cost.

Equation 14: Change in land information agency surplus from change to free fundamental data model from price discrimination

$$\Delta LIAS = -(1-g)F$$

Equation 15: Change in government consumer surplus from change to free fundamental data model from price discrimination

$$\Delta GCS = 0$$

The private sector gains the share of fixed costs that it previously paid for. Private consumers also gain the portion of the deadweight loss eliminated through moving to marginal cost pricing for private sector purchases. This is expressed in Equation 16, weighted by the cost of government funds.

Equation 16: Change in private consumer surplus from change to free fundamental data model from price discrimination

$$\Delta CS = \frac{(1-g)(F+DWL)}{1+\beta}$$

Summing the government and private consumer surplus gives the total change in welfare (Equation 17).

Equation 17: Total change in welfare from change to free fundamental data model from price discrimination

$$\Delta W = \Delta LIAS + \Delta GCS + \Delta GS$$

$$= -(1-g)F + \frac{(1-g)(F+DWL)}{1+\beta}$$

The change in welfare is positive where the total deadweight loss avoided is greater than the total fixed costs associated with the fundamental data product. This is shown in Equation 18.

Equation 18: Conditions for positive change in welfare from change to free fundamental data model from price discrimination[5]

$$DWL > \beta F$$

This is not as strong a condition in support of marginal cost pricing as that for the change from cost recovery pricing to the free fundamental data model (which was shown in Equation 9). This is because under the price discrimination model, government is already benefiting from marginal cost pricing with no excess cost of public funds. The further change to the free fundamental model requires that government funding, which have an associated cost of public funds, cover payments previously made by the private sector.

The other factor to consider in the comparison between the price discrimination and free fundamental data models is whether the elasticity of demand differs between the private sector and government. If government elasticity is higher, more of the gain through moving to marginal cost pricing comes from the government sector, with this gain already realised in the price discrimination model. Similarly, higher private sector elasticity provides a stronger case for the free fundamental data model. Given the lack of information on this point, it is not clear which is empirically the case.

6.4.2 Dynamics

Funding and quality

As for the two other policy changes considered above, a change in pricing policy has the potential to erode the initial welfare gains through declines in funding and quality.

The shift from the price discrimination to free fundamental data model sees the land information agency lose the revenue previously received from the private sector. If the level of private sector purchases is significant (which for many fundamental data products, may not be the case), there may be material impact on land information agency and total government revenue. To the extent that government does not supplement land information agency funding, there may be deterioration in the supply of the fundamental data.

This policy shift also results in the loss of the private sector price signal as to value. While price signals from the government sector had already been lost, the removal of private sector price signals leaves the land information agency completely dependent on alternative mechanisms to determine the appropriate level of supply.

Competition and innovation

The change from price discrimination to free fundamental data could increase competition and innovation in the production of value added products by removing the pricing barrier to entry. However, it may have deleterious effects when it comes to

[5] See Appendix A for the derivation of this equation.

production of fundamental data itself as the marginal cost supply to the private sector undercuts any private players in the fundamental data marketplace.

6.4.3 Qualitative analysis

This section qualitatively analyses issues concerning public good characteristics, positive spillovers, equity and hard constraints to access for the shift from the price discrimination model to the free fundamental data model.

Public good characteristics and internal spillovers

As noted previously, the free fundamental data model fully allows for public good characteristics, giving full scope all parties to use the non-rivalrous information, not just government. The precise delineation of which fundamental data are public goods should be subject to a product-by-product analysis.

Equity

If commercial users have a greater potential to pay, it could be argued that the shift to the free fundamental data model from price discrimination would reduce vertical equity.

Whether horizontal equity is improved is dependent on the extent to which the benefits of use by commercial users are spread among the broader community. If the commercial users are able to capture all of the benefits themselves, while the benefits of non-commercial use are diffuse, then the price discrimination model may be the more appropriate pricing model from a horizontal equity perspective.

Complexity

The shift to the free fundamental data model from price discrimination reduces complexity by removing the need to distinguish between commercial and non-commercial users. It also eliminates the requirement to price fundamental data that falls within the free data threshold.

There remains a need under either model to identify the data that the agency will make available for no charge, although that is also required under the free fundamental data model.

Raw data accessibility

The implications of allowing raw data accessibility are similar to those for the shift between the cost recovery and free fundamental data models. Raw data accessibility is more likely to promote competition in the cost recovery model, as the private sector will be able to compete in the processing of this raw data. If the agency releases the processed product free, as they would under the free fundamental data model, it is unlikely that any private sector activity will occur in processing.

6.4.4 Australian application

The changes in welfare resulting from a shift from the price discrimination to free fundamental data model represents the difference in the welfare effects of the changes

from the cost recovery model to price discrimination or free fundamental data. As is noted in the analysis of the conditions, the welfare change is reduced compared to the change from the cost recovery to price discrimination model, with the cost of public funds having a major effect on the net impact (Table 32). These estimates are derived using the equations described in section 6.4.1.

Table 32: Changes in welfare from adopting the free fundamental data model, relative to the price discrimination model

	Victorian topographic data	Landgate topographic data	Landgate aerial photography	Geoscience Australia topographic data
Total cost	$9.0 million	$2.9 million	$3.1 million	$13.3 million
Marginal cost	0	0	0	0
Elasticity	1	1	1	1
Government share	0.55	0.9	0.4	0.5
Multiplier	1	1	1	1
Δ land information agency surplus	-$4.1 million	-$0.3 million	-$1.9 million	-$6.7 million
Δ government consumer surplus	$0	$0	$0	$0
Δ total government surplus	-$4.1 million	-$0.3 million	-$1.9 million	-$6.7 million
Δ private consumer surplus	$4.9 million	$0.3 million	$2.2 million	$8.0 million
Total Δ in welfare	$0.8 million	$0.06 million	$0.4 million	$1.3 million

From this analysis, a shift to the free fundamental data model from price discrimination has a limited effect where there is a large government share of consumption. For example, for Western Australian topographic data, which is predominantly used by government, the change in welfare is less than $0.1 million.

The change in policy from price discrimination to free fundamental data is more likely to generate dynamic impacts where there is a low share of government use (i.e. Western Australian aerial photography). If commercial consumers are the major user, this change could significantly reduce land information agency funding and the ability of the agency to gauge the appropriate level of quality. As for the other examples above, this could erode short-term welfare gains. However, to the extent that the policy generates innovation and competition in value added markets, there is potential for this to generate increases in welfare.

One area where the dynamic impacts may be negative is on the competition for the production of the fundamental data product itself. In the case of aerial photography, where commercial providers are emerging, a change to the free fundamental data policy will hamper the ability of commercial providers to compete in the market. This lack of competition could reduce long-term efficiencies and innovation.

6.5 Commonwealth / State model

Like the price discrimination model, the Commonwealth / State model is a hybrid between the cost recovery and free fundamental data models, but in this case, on the dimension of jurisdiction.

In the analysis of the shifts between the models, the free fundamental data model was preferred for both the Commonwealth and the States. However, there may be grounds for differences between the Commonwealth and the States that would make the free fundamental data model more highly preferred for the Commonwealth.

The first of these grounds may be a difference in the cost of public funds between the Commonwealth and the States. If the cost of public funds were higher for the States than the Commonwealth, which would be the case if the States had a smaller and less efficient tax base, this would provide a bias towards cost recovery in the States and the free fundamental data model in the Commonwealth. Given the narrower tax base of the States, this might be a reasonable assumption.

Secondly, if the price elasticities of Commonwealth fundamental data products were higher than that for products produced by the States, the welfare gains from a free fundamental data model would be greater, providing a stronger basis for the free fundamental data model for the Commonwealth than the States. From the data available for this study, it is unclear if this is the case.

A further ground is if there was any difference between the ratios of fixed costs to total costs. A higher ratio of fixed costs for products produced by Commonwealth (or alternatively, a lower marginal cost) would favour this model. This is possibly the weakest ground as electronic distribution makes marginal cost in both cases effectively zero. There may be some difference in avoidable cost, particularly if data produced by the States require more maintenance to maintain quality and currency, although that is not typically the basis for drawing distinctions in pricing.

A final ground for different pricing policies is the dynamic consequence of a reduction in funding. If a product is a one off production and not subject to ongoing maintenance and updating, a reduction in funding is not going to reduce the quality or availability of that product in itself, but rather the production of other products. If the Commonwealth produced a higher proportion of data of this nature, there is a lower probability of declines in quality eroding initial welfare gains.

7 Delivery of agency objectives

Governments and land information agencies of governments may have a range of policy objectives and priorities that will affect the optimal choice of pricing model for fundamental data. Differences in objectives may be reason for variance between jurisdictions in the optimal pricing model.

Table 33 indicates how different policy objectives and priorities affect the optimal choice of pricing model. The number of ticks in each cell of the table indicate how well a pricing model performs against the objective, with three ticks indicating the best performance.

Differences in government objectives may be reason for variance between jurisdictions in the optimal pricing model. The Commonwealth / State model may be adopted on this basis.

Table 33: Delivery of objectives by model

Objective	Full cost recovery	Price discrimination	Free fundamental data
Economic development	✓✓ Less benefit than alternative models in short term, but may be superior in long term	✓✓ Less support to economic development than the free fundamental data model but the gap is small where the share of use by non-commercial user is large	✓✓✓ Maximises the use of fundamental data and the contribution and spillover benefits of fundamental data to economic development.
Use of fundamental data by government agencies	✓✓ Government agencies have to pay for use of fundamental data and hence are motivated to restrict use	✓✓✓ Government agencies receive fundamental data for free or minimal price and hence are motivate to maximise use	✓✓✓ Government agencies receive fundamental data for free or minimal price and hence are motivate to maximise use
Generation of government revenue	✓✓✓ Maximises revenue generation and makes data production independent of direct appropriations of government funding	✓✓ There is some reduction in government revenue where fundamental data are used by non-commercial users.	No revenue generated
Accountability of data producers to funders of fundamental data production	✓✓✓ The requirement of land information agencies to derive revenues from data sales makes these agencies responsive to the needs of data users	✓✓ Land information agencies may be responsive to the needs of commercial users of data, but less responsive to government and non-commercial users	✓ As land information agencies do not rely on revenues from data sales, there is no commercial motivation to be responsive to the needs of data users

Objective	Full cost recovery	Price discrimination	Free fundamental data
Availability of data to the community to inform public participation in public policy and government decision making	✓ Public, non-commercial use of data may be restricted by limited capacity to pay prices.	✓✓ Fundamental data are freely available to non-commercial users	✓✓✓ Fundamental data available to all commercial and non-commercial users
Promotion of competition in production of fundamental data	✓✓✓ Competition in production of fundamental data is promoted as private data production firms may compete on a competitively neutral basis with government land information agencies	✓✓ Free provision of fundamental data to government agencies and non-commercial users limits the market opportunities for private data production firms	✓ Free provision of fundamental data from government land information agencies lessens commercial opportunities for private data production firms
Promotion of competition in downstream markets for services and products using fundamental data	✓ Less use of fundamental data reduces the opportunities for competition in products and services	✓ Less use of fundamental data by commercial users reduces the opportunities for competition in products and services	✓✓✓ Free provision of fundamental data promotes competition in products and services

Appendices

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Appendix B Mathematical derivation

1 Derivation of deadweight loss (no multiplier)

Linear demand curve

$$DWL = \frac{1}{2}(p_{AC} - p_{MC})(q_{AC} - q_{MC})$$

$$= \frac{1}{2}(p_{AC} - p_{MC})^2 \frac{q_{AC}}{p_{AC}} \frac{(q_{AC} - q_{MC})/q_{AC}}{(p_{AC} - p_{MC})/p_{AC}}$$

$$= \frac{1}{2}(p_{AC} - p_{MC})^2 \frac{q_{AC}}{p_{AC}} \varepsilon$$

$$= \frac{1}{2}\varepsilon \frac{(p_{AC} - p_{MC})}{p_{AC}}(p_{AC} - p_{MC})q_{AC}$$

$$= \frac{1}{2}\varepsilon \frac{(p_{AC} - p_{MC})}{p_{AC}} F$$

$$= \frac{1}{2}\varepsilon \frac{(p_{AC} - p_{MC})}{p_{AC}} \frac{q_{AC}}{q_{AC}} F$$

$$= \frac{1}{2}\varepsilon \frac{F^2}{TC}$$

Isoelastic demand curve

$$DWL = \int_{pMC}^{pAC} Ap^{-\varepsilon} - F$$

$$= \frac{A}{1-\varepsilon}[p^{1-\varepsilon}]_{pMC}^{pAC} - F$$

$$= \frac{A}{1-\varepsilon}(p_{AC}^{1-\varepsilon} - p_{MC}^{1-\varepsilon}) - F$$

$$= \frac{A}{1-\varepsilon}(p_{AC}^{1-\varepsilon} - p_{AC}^{1-\varepsilon}\left(1 - \frac{F}{TC}\right)^{1-\varepsilon}) - F$$

$$= \frac{Ap_{AC}^{1-\varepsilon}}{1-\varepsilon}(1 - \left(1 - \frac{F}{TC}\right)^{1-\varepsilon}) - F$$

$$= \frac{q_{AC}\, p_{AC}}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right)-F$$

$$= \frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right)-F$$

2 Change of welfare when shift from cost recovery to free fundamental data (no multiplier)

Linear demand curve

$$\Delta LIAS = -F$$

$$\Delta GS = g\frac{1}{2}\varepsilon\frac{F^2}{TC}+gF$$

$$\Delta CS = \frac{(1-g)\left(F+\frac{1}{2}\varepsilon\frac{F^2}{TC}\right)}{1+\beta}$$

$$\Delta W = g\frac{1}{2}\varepsilon\frac{F^2}{TC}-(1-g)F+\frac{(1-g)\left(F+\frac{1}{2}\varepsilon\frac{F^2}{TC}\right)}{1+\beta}$$

ΔW positive where:

$$(1+\beta g)\tfrac{1}{2}\varepsilon\tfrac{F}{TC} > (1-g)\beta$$

Isoelastic demand curve

$$\Delta LIAS = -F$$

$$\Delta GCS = g\left(\tfrac{TC}{1-\varepsilon}\left(1-\left(1-\tfrac{F}{TC}\right)^{1-\varepsilon}\right)-F\right)+gF$$

$$= g\tfrac{TC}{1-\varepsilon}\left(1-\left(1-\tfrac{F}{TC}\right)^{1-\varepsilon}\right)$$

$$\Delta CS = \frac{(1-g)\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right)}{1+\beta}$$

$$\Delta W = \Delta LIAS + \Delta GCS + \Delta CS$$

$$= g\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right) - F + \frac{(1-g)\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right)}{1+\beta}$$

ΔW positive where:

$$(1+\beta g)\left(\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right) - F\right) > (1-g)\beta$$

3 Change of welfare when shift from cost recovery model to price discrimination (no multiplier)

Linear demand curve

$$\Delta GS = g\frac{1}{2}\varepsilon\frac{F^2}{TC}$$

$$\Delta CS = 0$$

$$\Delta W = g\frac{1}{2}\varepsilon\frac{F^2}{TC}$$

ΔW always positive

Isoelastic demand curve

$$\Delta GS = g\left(\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right) - F\right)$$

$$\Delta CS = 0$$

$$\Delta W = g\left(\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right) - F\right)$$

ΔW always positive

4 Change of welfare when shift from price discrimination model to free fundamental data (no multiplier)

Linear demand curve

$$\Delta GS = -(1-g)F$$

$$\Delta CS = \frac{(1-g)\left(F + \frac{1}{2}\varepsilon\frac{F^2}{TC}\right)}{1+\beta}$$

$$\Delta W = -(1-g)F + \frac{(1-g)\left(F + \frac{1}{2}\varepsilon\frac{F^2}{TC}\right)}{1+\beta}$$

ΔW positive where:

$$\frac{1}{2}\varepsilon\frac{F}{TC} - \beta > 0$$

Isoelastic demand curve

$$\Delta GS = -(1-g)F$$

$$\Delta CS = \frac{(1-g)\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right)}{1+\beta}$$

$$\Delta W = \Delta GS + \Delta CS$$

$$= -(1-g)F + \frac{(1-g)\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right)}{1+\beta}$$

ΔW positive where:

$$\frac{TC}{1-\varepsilon}\left(1-\left(1-\frac{F}{TC}\right)^{1-\varepsilon}\right) - F > \beta F$$

Appendix C Summary of static welfare analysis

Table 34 summaries the results of the static welfare analysis. The changes in welfare are separated into changes in government consumer surplus (ΔGCS), land information agency surplus (ΔLIAS) and private consumer surplus (ΔCS), which when summed gives the total change in welfare (ΔW).

Table 34: Summary of static welfare analysis results

	Shift from cost recovery to free fundamental data	Shift from cost recovery to price discrimination	Shift from price discrimination to free fundamental data
ΔGCS	$gDWL + gF$	$gDWL + gF$	0
ΔLIAS	$-F$	$-gF$	$-(1-g)F$
ΔCS	$\frac{(1-g)(F+DWL)}{1+\beta}$	0	$\frac{(1-g)(F+DWL)}{1+\beta}$
ΔW	$gDWL - (1-g)F + \frac{(1-g)(F+DWL)}{1+\beta}$	$gDWL$	$-(1-g)F + \frac{(1-g)(F+DWL)}{1+\beta}$
ΔW >0 when	$(1+\beta g)DWL > (1-g)\beta F$	Always	$DWL > \beta F$

Appendix D Glossary

Term	Definition
Avoidable costs	Costs that would be avoided if production of a particular output or service of a particular customer class was ceased
Basic information (product) set	Information products characterised by a high degree of non-rivalry and non-excludability to potential users (public good characteristics) and significant positive externalities
Competitive neutrality	Policy principle that requires prices charged by government businesses to reflect full cost attribution and to account for any competitive advantages and disadvantages of public ownership
Consumer welfare	Collective benefit derived by consumers of a product or service. Typically defined as the difference between the amount they are willing to pay and the price that is paid
Cost plus	Pricing model where the price is determined from the actual cost of production and includes an agreed mark-up or rate of return
Cost recovery	Pricing model where the price is determined with regard to all costs attributed to data production, that is, equal to average long-run costs
Creative Commons	A non-profit organisation that has built a range of free licences that allow content owners to specify which rights they retain in their works and which rights they will waive
Crown copyright	A form of copyright protection claimed by government and in Australia, defined in the *Copyright Act 1968*
Custodian	The body responsible for the development and management of a dataset, including determining the conditions of use and distribution of the dataset
Deadweight loss	The loss is welfare resulting from pricing a product above marginal cost

Term	Definition
Differential pricing	Pricing model where different customer groups or uses are charged different prices for the same or similar products
Direct costs	Costs that can directly and unequivocally be attributed to an output
Economically efficient pricing	Setting prices to deliver the maximum social welfare benefit
Externality	Indirect (positive or negative) welfare effects of decisions to produce or consume on firms or individuals other than producers or consumers of the product
Fixed costs	Costs that remain unchanged irrespective of the volume of output produced. Equal to total costs minus variable costs.
Fundamental data	An authoritative source of spatial data that is maintained to well defined quality standards and cannot be derived from another dataset
Indirect costs	Costs that are not directly attributable to an output and are often referred to as overheads
Intellectual property (IP) rights	Rights granted by law in relation to copyright, inventions, registered and unregistered trademarks, registered designs, and all other rights resulting from intellectual activity in the industrial, scientific, literary and artistic fields
Marginal cost of public funds	The collection, compliance and deadweight losses associated with raising tax revenues
Marginal cost pricing	Pricing model where the price is equal to the cost of supplying one extra unit of a good or service
Marginal cost	Cost of producing one additional unit of a good or service
Market failure	Situation where the characteristics of a market lead to inefficient resource allocation

Term	Definition
Metadata	Data providing information about other pieces of data
Natural monopoly	Situation where a single firm can meet market needs more efficiently due to high fixed costs and low variable costs
Non-excludability	Where after provision of a good or service to one consumer, other consumers cannot be excluded from also using the good or service
Non-rivalry	Where provision of a good or service to one person does not diminish the availability of the good or service to others
Price discrimination	Practice of charging separate customer groups or uses different prices for the same or similar products
Price elasticity of demand	Responsiveness of the demand for a product or service to a change in its price
Public good	Good or service characterised by a high degree of non-rivalry and non-excludability
Public sector information (PSI)	Information products and services that are generated, created, collected, processed, preserved, maintained, disseminated, or funded by a public sector organisation
Ramsey pricing	Pricing regime which maximises social welfare by pricing according to the demand elasticity of different customer groups through price discrimination
Raw data	Data in its most basic state without any additional manipulation or analysis
Spatial data	Data about the location and attributes of features that are on, above or beneath the surface of the earth. Also referred to as land data or geographic data.

Term	Definition
Spillover	Indirect (positive or negative) welfare effects of decisions to produce or consume on firms or individuals other than producers or consumers of the product
Value added data	Raw or fundamental data that is manipulated, edited, compiled or otherwise processed to enhance its value and facilitate its use and effectiveness for the end user
Value added re-seller (VAR)	Business entity that resells data, after having added value to the product
Variable costs	Costs that change in proportion to changes in the quantity of output produced
Welfare	The net benefits (or economic surplus) accruing to consumers and producers